UNIV MICROFILMS INC
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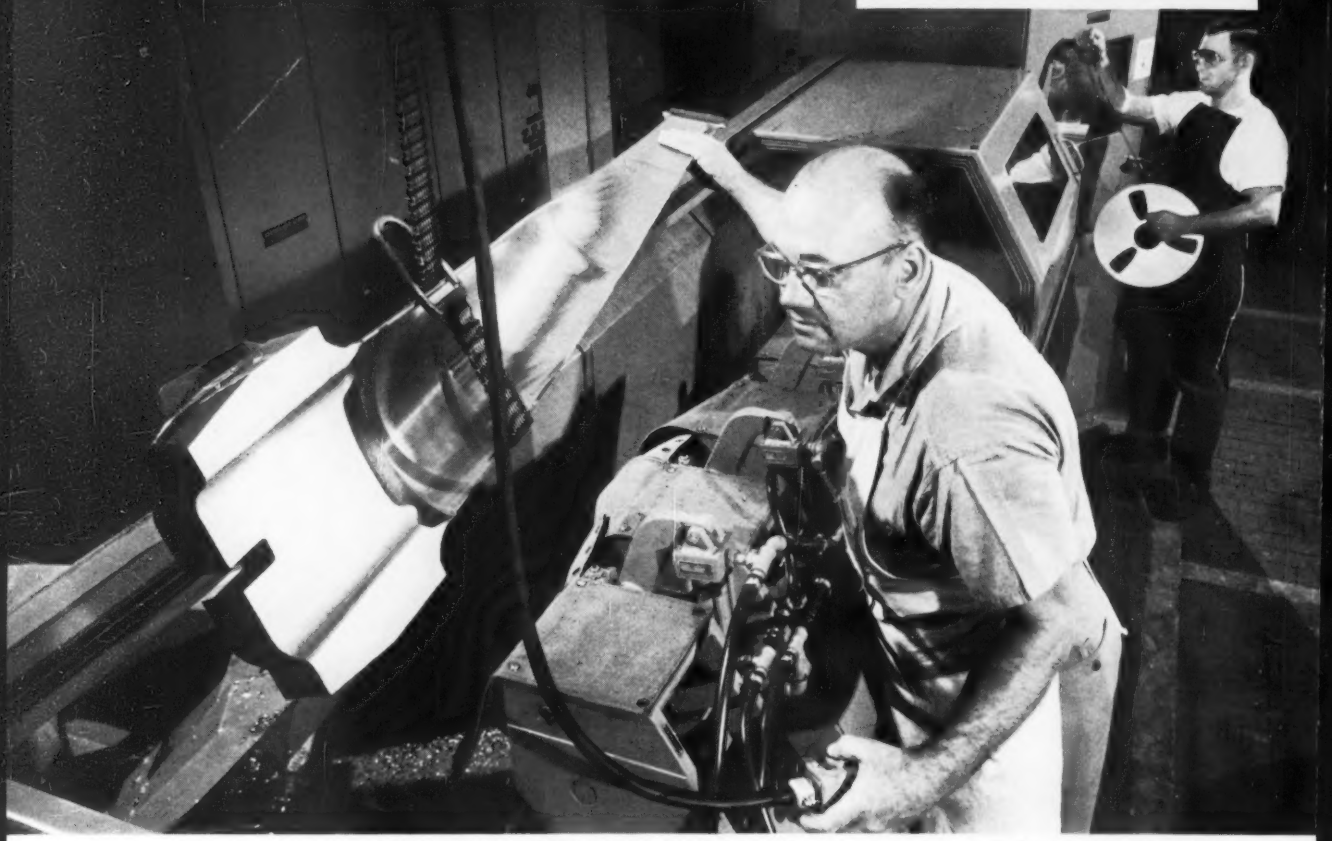
General Electric reports on developments in . . . **POWER GENERATION**



THE MAGNETIC TAPE-CONTROLLED MILLING MACHINE above is being set up for production of the new 50-inch buckets. This is the first application of numerical control for machining complex-shaped steam turbine buckets. This new manufacturing technique will result in stronger, more efficient, more economical buckets.

FIRST 50-INCH TURBINE BUCKET

THIS G-E ENGINEERING TEAM was instrumental in the development of the 50-inch bucket. Left to right, V. S. Musick, A. Rubio (standing), J. H. Ouellette, J. E. Corr.

GENERAL ELECTRIC is building for 1961 shipment the first 1800-rpm steam turbine with 50-inch last-stage buckets. This latest milestone in turbine design was achieved through the use of new, advanced mathematical design techniques. Extensive laboratory tests were conducted to assure that the new bucket will maintain the high-reliability and long-life qualities of its predecessors.

IMPROVED EFFICIENCY AND HIGHER RATINGS are made possible by the 50-inch bucket. The increased exhaust area permits better utilization of last-stage steam energy and can result in efficiency gains of 1% or more over the present 43-inch last-stage bucket. Higher unit ratings can now be attained without increasing the number or complexity of turbine casings. For example, the ratings of many cross-compound turbine arrangements can be extended as much as 33%.

REDUCED POWER GENERATION COSTS will result from the 50-inch bucket—and from General Electric developments yet to come. By co-ordinating its engineering research, development, and design efforts with those of electric utility engineers, and by making available new and better apparatus for generation, transmission, and distribution, General Electric will continue to help utilities meet America's rapidly increasing demand for low-cost power. 604-06

GENERAL ELECTRIC

Electrical World

Vol. 154, No. 6 AUGUST 8, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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Missouri Basin states group plans 345-kv transmission grid and 500-kv link with BPA.....p 28

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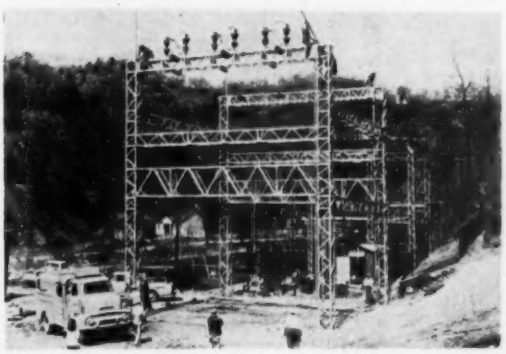
Public power men elected president and vice president of Canadian Electrical Assn.....p 34

Special Report



Substation Design for Tomorrow

A close look at future bulk and distribution substations shows a broad evolution in design, as utility men steer between rising costs and increasing public resistance. Included are results of a nationwide survey, plus articles on standardization, noise reduction, structural materials, and comparative costs.....p 39

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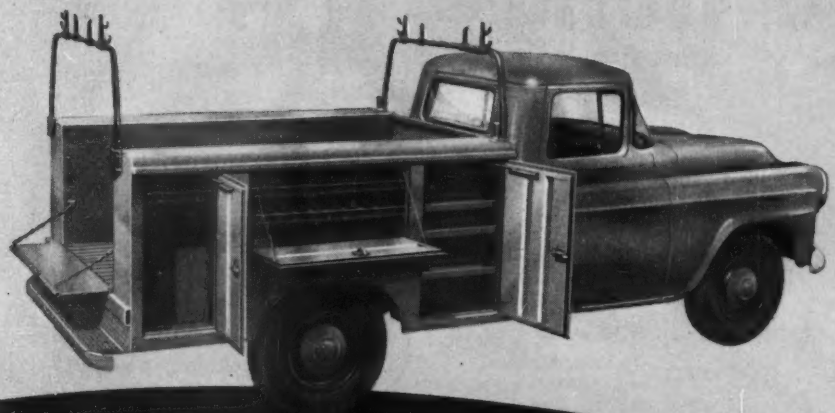
SERVICE AND MAINTENANCE BODIES



Four Models . . . Four Sizes

COMPARTMENTIZED TO FIT SPECIFIC JOB NEEDS

Which Series 22 Body do you need? Take a look . . . there's a model especially designed for your particular type of service work. The durable, all-steel unit shown above, equipped with an optional overhead rack, is widely used for general service work in all operations. Other models for electric, telephone and gas service have similar compartments fitted with various shelves and bins to meet specific work needs. Result: You get a custom-made body at a mass-produced price . . . plus increased crew efficiency on every job.

Series 22 Body features include flat, 16-gauge compartment tops . . . rust-proof, cadmium-plated door latches . . . nylon bushings in all door hinges . . . key-locking, weathertight doors . . . recessed, slam-action door catches . . . corrugated steel floor.

Available in 75″, 90″ and 104″ lengths, equipped with accessories to fit your particular need.

Need more storage space? Any of the four Series 22 models can be furnished with an all-steel superstructure. In addition to any optional items desired, the superstructure is fitted with two full-length shelves and three swivel hooks on each side, a window in the head panel and grab handles at the rear.

Self-Elevating Ladder Assembly

This time-saving assembly with six rubber-covered rollers and four powerful coil springs enables one man to quickly and effortlessly erect a ladder up to 36′ in length. The operator lightly pushes the end of the ladder down, and the springs do the lifting. Stowing is equally fast and easy. Ideal for use on 75″, 90″ and 104″ bodies. Includes 28′, 30′, 32′, 34′ or 36′ two-section extension ladder.

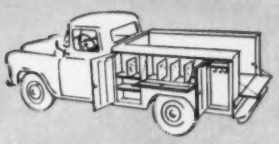
FOR ELECTRIC WORK

Series 22-E. Designed for service work in any phase of the electric utility industry. Special shelves and bins carry all the equipment and materials needed in the field.

FOR TELEPHONE WORK

Series 22-T. Compartmentized to carry a variety of telephone service tools, parts and materials. Standard arrangement of shelves and bins enables crewmen to quickly find items needed on the job.

FOR GAS WORK



Series 22-G. Two variations of this model are available for carrying either cast or tin meters. Rubber-padded compartments insure the safe storage of fragile parts and instruments.

Plenty of additional bins, shelves and racks carry tools, pipe, fittings, parts and all other equipment needed on routine or emergency service and maintenance calls.

Another reason why
UTILITIES EXPECT MORE FROM

POWERS *American*

UTILITY BODIES AND EQUIPMENT

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LETTERS

Why Not Ads on Backs of Articles?

To the Editor:

The perforations on *Electrical World* pages are of great value, enabling the various contributions to be removed if required for distribution to the several engineers and other officers interested in the articles from time to time.

I would suggest that the facility could be further improved if advertisements were so placed that the removal of any particular article would not interfere with adjacent items. For instance, in the issue of June 13, pages 54 and 55 would be normally removed and distributed to the mains engineers interested in underground supplies to Caravan Parks, but if this were done it would mutilate the articles on pages 56 and 57 with which the substation engineer would be concerned.

The same disability exists at times with respect to the Engineering Reference Sheets which are almost invariably removed and filed.

I submit the above for your consideration.

J. E. Colquhoun
Box 169
Wagga Wagga, New South Wales

▶ *Thank you, Reader Colquhoun, for your interest in* Electrical World. *We always welcome comments and suggestions from our readers as to how we can make the magazine more useful. As to this particular suggestion, we feel that the tone of our presentation would suffer and our mechanical problems would be greatly increased. It did our hearts good to see that your letterhead carried the "Live Better Electrically" symbol, which must mean you are carrying the message to New South Wales.*

Excellent CIGRE Coverage

To the Editor:

Congratulations on the excellent article by Mr Braymer at the CIGRE Conference in Paris (EW, July 25, p 54).

Where can we secure a copy of the transactions of this 18th International Conference of Large Electric Systems?

Is our library eligible for a copy?

Virginia J. Edgington, Librarian
Georgia Power Co
Atlanta, Ga.

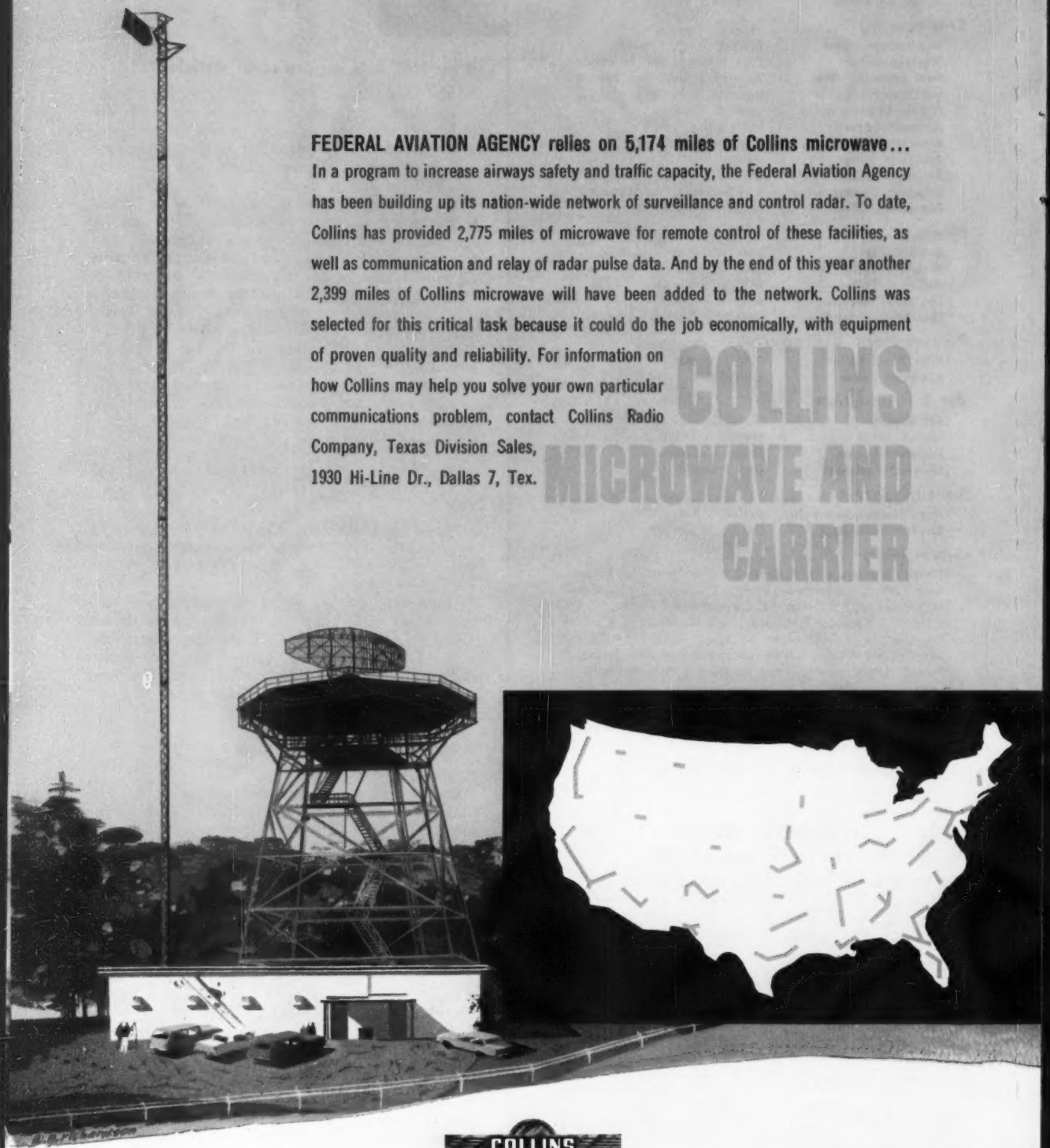
▶ *Thank you, Mrs Edgington, for your kind words. Copies of the transactions are available from J. Tribot Laspiere, vice president of CIGRE,* 112 *Boulevard Haussmann* 8, *Paris. Be sure to specify that you want the transactions in English.*

Correspondence to this column should be addressed to Letters Editor, Electrical World, 330 *W* 42*nd St, New York* 36, *N. Y.*

FEDERAL AVIATION AGENCY relies on 5,174 miles of Collins microwave...

In a program to increase airways safety and traffic capacity, the Federal Aviation Agency has been building up its nation-wide network of surveillance and control radar. To date, Collins has provided 2,775 miles of microwave for remote control of these facilities, as well as communication and relay of radar pulse data. And by the end of this year another 2,399 miles of Collins microwave will have been added to the network. Collins was selected for this critical task because it could do the job economically, with equipment of proven quality and reliability. For information on how Collins may help you solve your own particular communications problem, contact Collins Radio Company, Texas Division Sales, 1930 Hi-Line Dr., Dallas 7, Tex.

COLLINS MICROWAVE AND CARRIER



COLLINS

COLLINS RADIO COMPANY • DALLAS, TEXAS • CEDAR RAPIDS, IOWA • BURBANK, CALIFORNIA

You can save money on delivery time... with Graybar as your auxiliary warehouse

Multiple orders require separate handling, shipping and billing. Plus follow-up, individually and often. There's a good chance you can save a great deal of time just by ordering from your nearby Graybar warehouse. It's that simple.

Moreover, you avoid uncertainty. For delivery to your central warehouse or sub-store is by truck, directly under your control or ours.

Start with a local call . . . Phone in your bill of materials. We'll have it assembled for loading by the time your pickup arrives. Or a Graybar truck will highball it out to you.

Employee-owned Graybar, a part of your local community, has served utilities continuously since the first lines went up. Whether you require 3 items or 3,000 you'll find Graybar your nearest source for most of what you need.

Start things rolling. Call your Graybar man.

When Graybar is your auxiliary warehouse –	You save on storeroom costs Reduce inventory investment Insure prompt delivery Step up man-hour efficiency Simplify bookkeeping

931

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Everything Electrical GraybaR ELECTRIC COMPANY

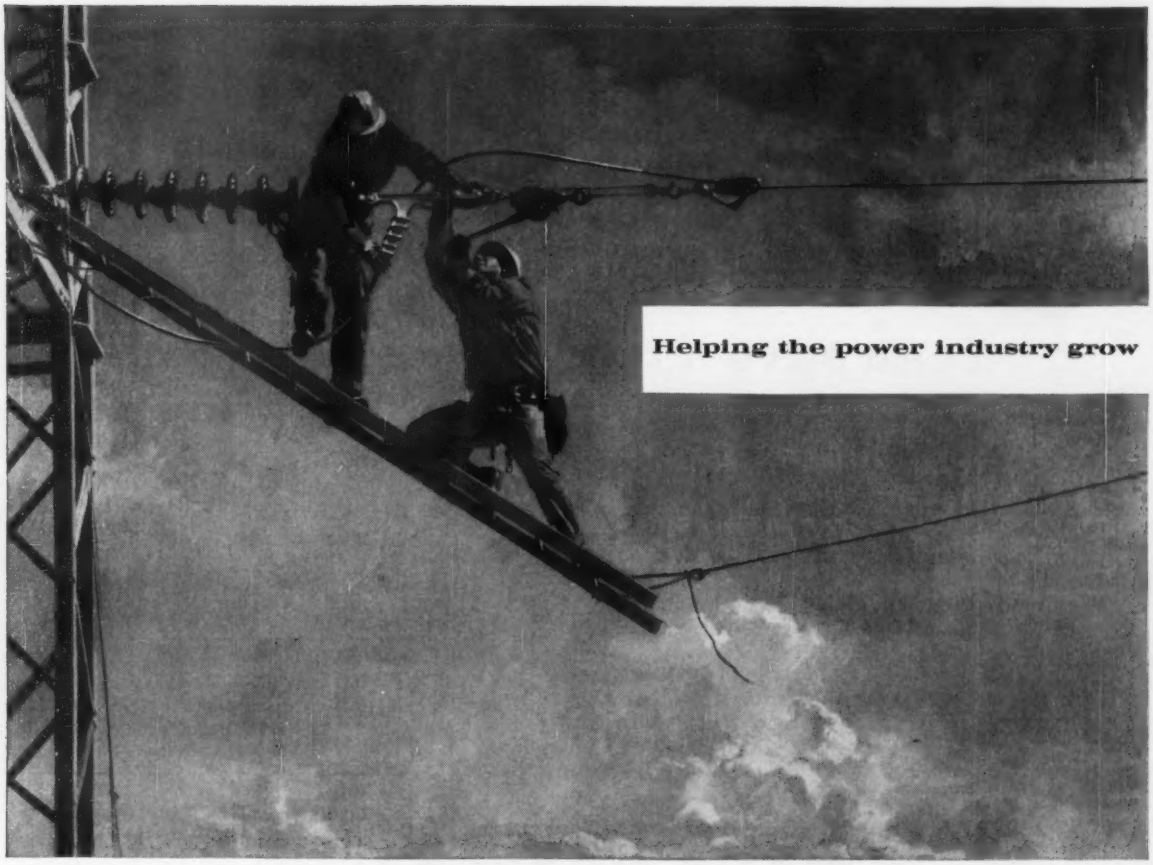
IN OVER 130 PRINCIPAL CITIES

LOCAL SERVICE TO UTILITIES THROUGH COAST-TO-COAST WAREHOUSING

Aerial Teamwork

Working outside the frame of a high steel tower, sure-footed construction men string a powerline with the help of a come-along. Varied skills and long experience are prime factors to consider when selecting a firm to execute a power project. United Engineers has worked with many well-known utilities and industrial firms in designing and constructing hydroelectric and thermal plants, electric substations, and installations for supplying heating and process steam. Our skills and creativity can augment your engineering staff as required. We invite you to profit from our background of 75 years' experience as designers, construction engineers and engineering consultants.

Painting by Stanley Meltzoff



Helping the power industry grow

UNITED ENGINEERS

& Constructors Inc • U.E.&C. (Canada) Ltd. • New York • PHILADELPHIA • Chicago

WESTINGHOUSE improves new transformers 5 ways with aid of REVERE ROLLED COPPER in coil winding

New design extends range of lightweight pole-type transformers to 500 Kva

In seeking to solve the problem of cross-sectional requirements in the winding of conductors in low-voltage coils of large Distribution Transformers, Westinghouse design engineers noted that their primary concern was: How to reduce the number of individual conductors in the low-voltage windings.

The final design is one which uses a sheet of copper across the width of the low-voltage coil so that one turn becomes one layer. The thickness of the sheet is varied to give the required sectional areas (see photo lower left).

Westinghouse engineers, in collaboration with Revere and other suppliers, wrestled with the problem of securing a satisfactory sheet material for this purpose for over a year. The layer insulation was designed to be sufficient for turn-to-turn insulation; this eliminated, from an electrical standpoint, the need for insulated sheet copper. However, this method presented still another problem. For, to accomplish this, the copper sheet had to be sufficiently burr free to permit the use of a single sheet of thin layer insulation. The answer to this problem was the development of a smooth Revere Rolled Copper sheet, which contributed to giving the new Westinghouse sheet-wound copper design transformer the following outstanding advantages:

1. A compact coil of great inherent mechanical strength against short circuit forces.

2. Reduction in losses and impedance by reducing the high-low space to a minimum.

3. Weight reduction directly through reduced mean turn and indirectly by eliminating coil bracing.

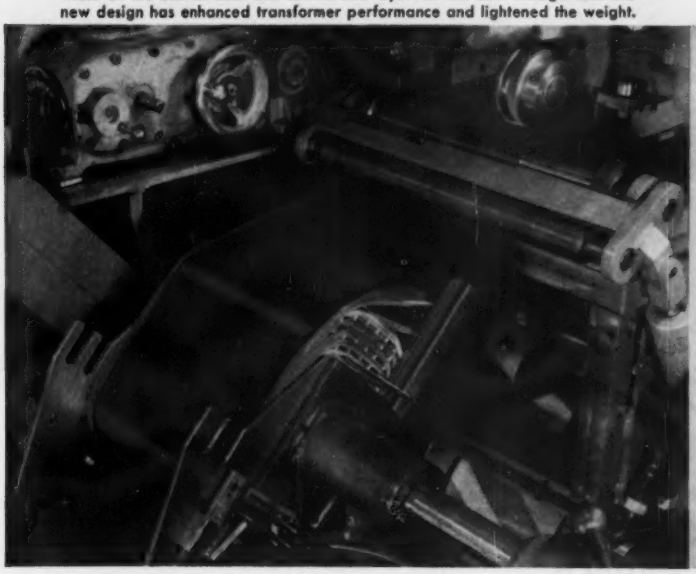
4. More effective cooling obtained by removing coil blocks and braces.

5. Total lower weight of unit which permitted extension of pole mountings to ratings which were previously available only in the substation type.

Find out today how Revere Rolled Copper can be used to advantage in your coil winding application.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.
Mills: Rome, N. Y.; Baltimore, Md.; Chicago, and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

PACE-SETTING sheet-wound coil design uses a sheet of copper across the width of the coil so that one turn is one layer of the Low-voltage coil. The new design has enhanced transformer performance and lightened the weight.



ONE OF THE WESTINGHOUSE transformers—a 500 Kva, 7200 Volt rating—incorporating the new design. Previously available only in the substation type.

See What Square D's Front-Connected *POWER-STYLE* Switchboards Offer!

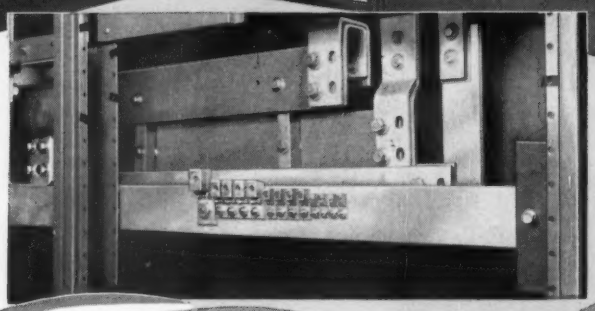
NEW!

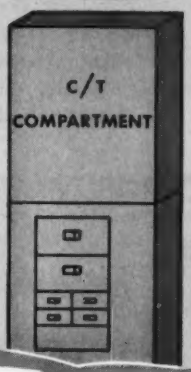
First *completely standardized* switchboard built specifically for small and medium-size installations. Bus bars designed to assure *cool operation in a depth of 14 inches!*

Complete *front accessibility* allows all bus bars and branch circuit connections to be installed and removed *from the front!* Permits mounting directly against wall.

Off-center mounting of breakers (or QMB fusible switches) in right hand section provides maximum room for installing cables from larger units.

Standardized C/T compartment built to meet Edison Electric Institute and Public Utilities' specifications.





Completely standardized horizontal bussing is available up to 2000 amperes, at either top or bottom. Notice bus bar drillings for extension to future sections.

Standardized C/T compartment designed to provide most flexible arrangement. Available in either "hot" or "cold" sequence, top or bottom feed. When used without main disconnect in "hot" sequence, up to six subdivisions can be mounted in same section with C/T compartment.

Write for descriptive bulletin SD-116
Address Square D Company, Mercer Road, Lexington, Kentucky

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wherever electricity is distributed and controlled

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Save up to 80% of your programming costs...put solid state IBM 7070 to work for you...faster.

Ready to use—right off the shelf—IBM's pretested utility program* slashes the time and cost of getting your Customer Billing and Accounting into full-scale operation on the 7070.

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Your local IBM representative will be glad to show you a color movie demonstrating how this new IBM service can save you time and money—improve your customer accounting. Call him today.

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In the heart of Lake Charles...

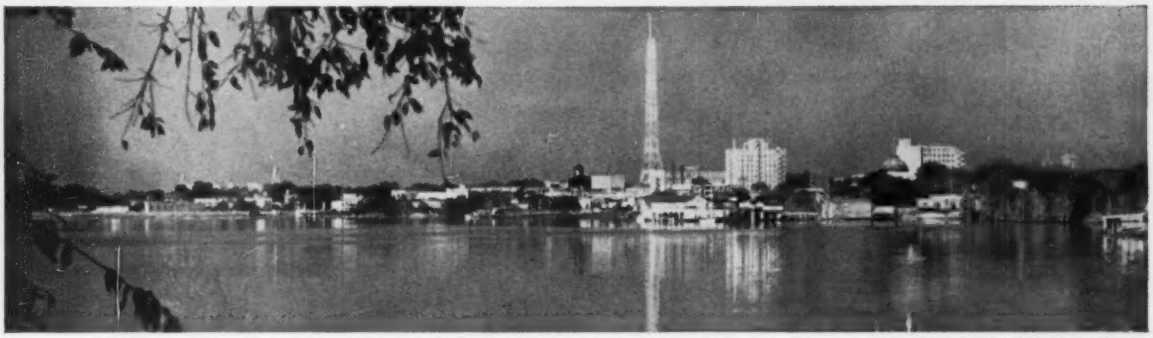


Photo by Rybiski, Lake Charles, Louisiana

Lake Charles, Louisiana ... city on the move. Industrial hub of the Gulf Coast. Major port and center of Louisiana's petroleum industry. Big producer of chemicals. Home of the world's largest rice mill. Good home, too, to 70,000 people.

In Lake Charles, the demand for power grows—steadily, in the long run, but with daily and seasonal demands varying from light to heavy. These fluctuating demands emphasize the importance of automatic voltage regulation to maintain steady voltage under all load conditions. That's why the Gulf States Utilities Company has recently installed a 7500 Kva Wagner Load Tap Changing Power Transformer in the downtown commercial area.

This compact unit utilizes a new design in the load tap changing mechanism, which has been greatly simplified to provide quiet operation and long operating life with extremely little maintenance.

Constant research and development have kept Wagner up front in transformer design for more than 65 years ... made Wagner a leader in power planning. So, remember this:

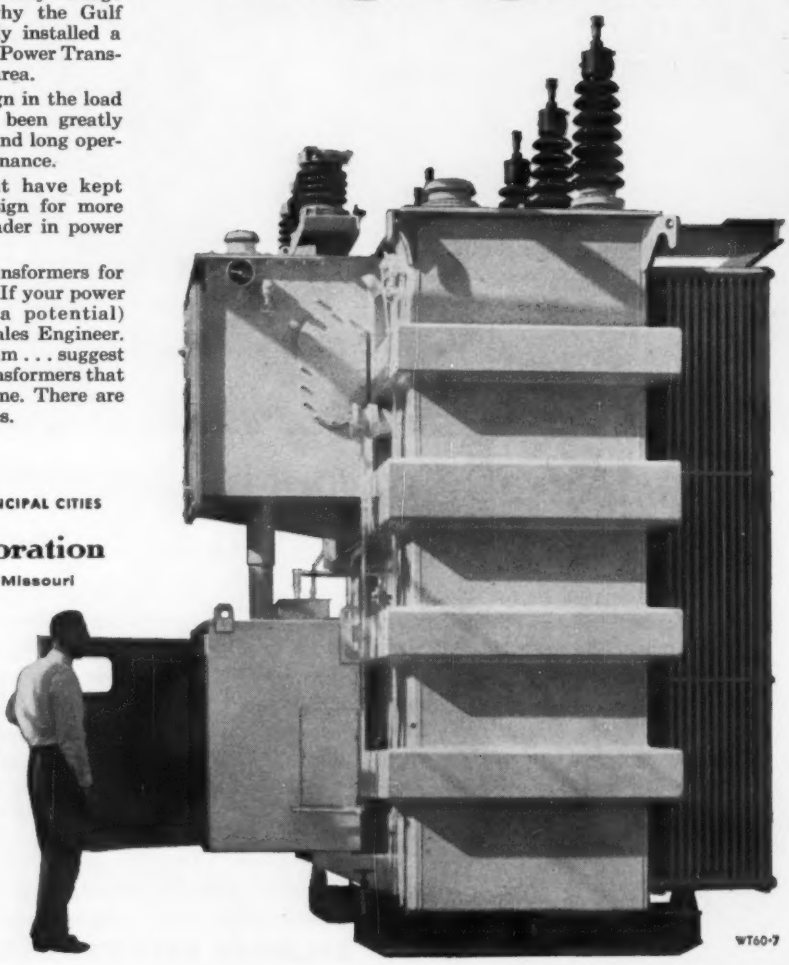
Wagner makes a complete line of transformers for industrial and power company needs. If your power needs present a critical (or even a potential) problem, call your nearby Wagner Sales Engineer. He'll help you plan your power program ... suggest Wagner power and unit substation transformers that will meet your needs for years to come. There are Wagner branches in 32 principal cities.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6456 Plymouth Ave., St. Louis 33, Missouri

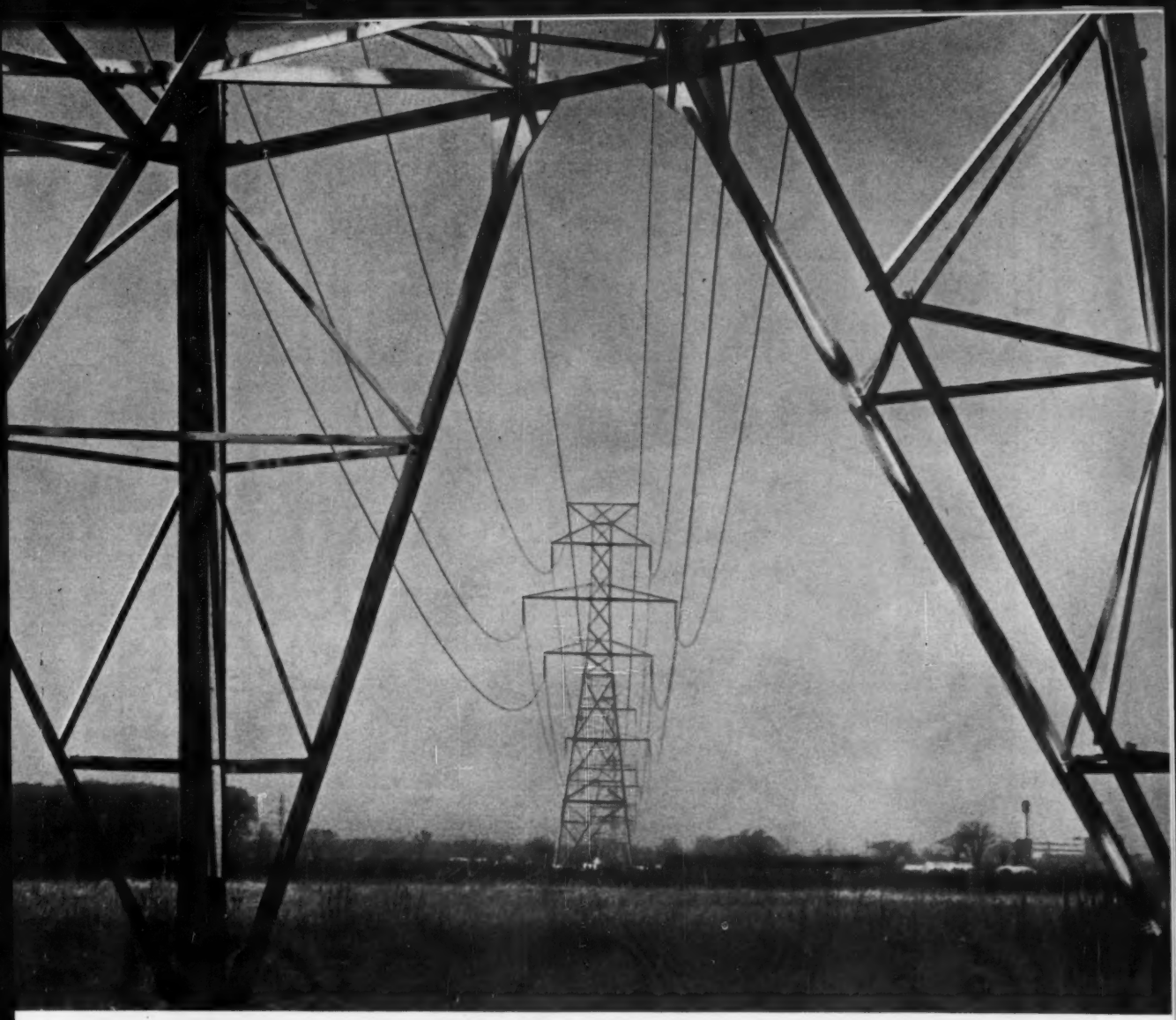
This Wagner LTC TRANSFORMER Assures Automatic Voltage Regulation



Wagner magnetic amplifier control equipment senses any voltage fluctuation in the line and automatically regulates the voltage to meet the demand.

LIVE BETTER ELECTRICALLY

WT60-7



Bethanized Strand protects Niagara Mohawk line

Here is part of a 47-mile transmission line near Buffalo, built recently for Niagara Mohawk Power Corporation. Because the line traverses an industrial area, Bethanized "C" coated strand was selected for overhead ground wires. The ground wire, manufactured to ASTM Specification A-363, is 7/16-in. 7-wire extra-high-strength strand.

With Bethanized strand, you can select from four coating weights to provide adequate protection against corrosion. The coating is applied by Bethlehem's special electrolytic process which makes possible a uniform, tightly bonded zinc coating that is 99.9 pct pure.

The "A" coating weight is intended for service where atmospheric conditions are good. The "B" coating contains twice, and the "C" coating three times, the weight of the "A" coating. The "D" coating, which comes in common, Siemens-Martin and high-strength grades, contains four times the weight of the "A" coating. If you would like to have full details, write to the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Steel

for strength
. . . economy
. . . versatility

BETHLEHEM STEEL

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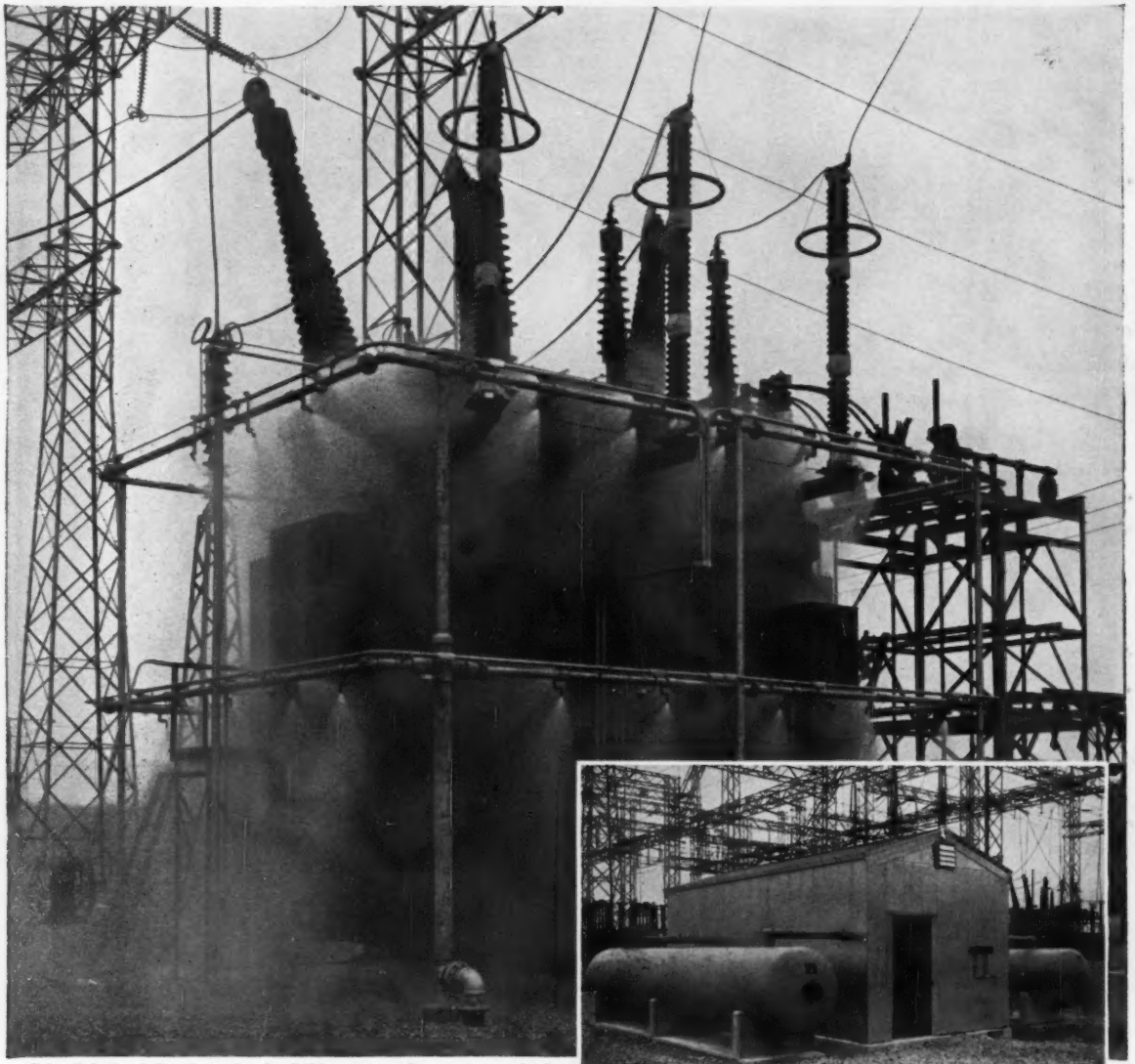


Grinnell Selfcon® Fire Protection for 345-kv autotransformers is completely self contained. It is of the deluge type, using nitrogen-pressurized water supply. Nozzles on piping looped at two levels thoroughly spray equipment and surrounding ground area.

Water tanks, insulated and heated against freezing, are pressurized (to maintain 50 psi minimum at nozzles) by nitrogen bottles inside the valve house.

Now you can have water spray protection against fire without public water supply

Limited water supply fire protection systems by Grinnell have been installed for transformers at two substations of a large midwestern utility. The system consists of water storage tanks and cylinders of compressed nitrogen gas, safely located out of the hazard area, and connected by piping to the water spray nozzles in the areas to be protected. Automatic fire detecting devices are connected back to the nitrogen cylinder release.

Should a fire break out, nitrogen is quickly released into the water tank, raising the pressure so that water is discharged from the spray nozzles with maximum extinguishing effect. The water capacity of the system provides a safety factor well in excess of extinguishing time.

Grinnell first introduced this type of water spray protection in America, and maintains that leadership through continuing research. An engineer from Grinnell's Fire Protection Division will gladly explain in more detail how the system works. Phone or write Grinnell Company, Providence 1, R. I. Branches in principal cities.

GRINNELL

AUTOMATIC FIRE PROTECTION SINCE 1870

The Electrical Week

FUTURE NEWS ▶ Sites for two more large nuclear power plants are being eyed by two eastern utilities.

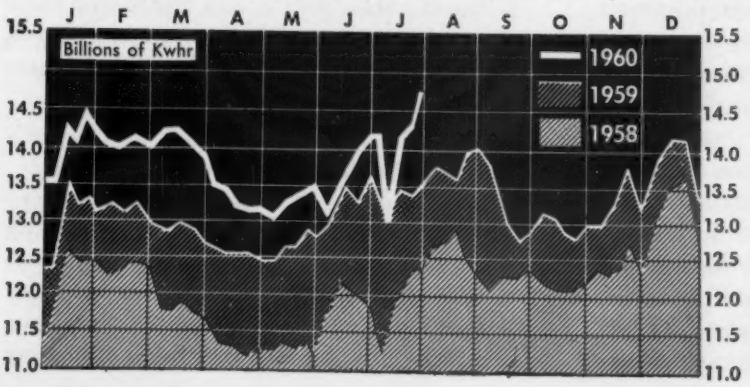
LATE NEWS ▶ **Around the States** . . . New peak energy use was racked up in week ending July 30. Total was 14,746,000,000 kwhr, 7.1% above previous year (see chart below) . . . REA sold $1,130,000 of new 2% bonds to 24 co-ops in first month of offering . . . Peace pact between TVA and Memphis will return $900,000 of disputed $2.5-million TVA rate increase to Memphis customers and provide surplus power swaps . . . Cleveland overhead-vs-underground battle gets second look as city hires consultant to study cost and extent of future transmission lines . . . AEC sets Aug. 24 for public hearing on construction permit for PG&E's 50-Mw Humboldt Bay nuclear plant . . . PRDC will petition US Supreme Court Aug. 12 for review of lower court order halting Enrico Fermi construction (EW 8/1/60, p 26).

Labor News . . . Kansas City P&L reaches peace pact, granting 4.5% wage hike, with IBEW production and clerical locals. However, these locals are respecting picket lines of the IBEW T&D local, on strike since July 12, but still negotiating . . . 1,400 UWA employees ratify 4% increase agreement with Ohio Ed. Similar offer is turned down by IBEW and splinter local . . . Operating Engineers at Union Electric reject 2-year contract offer. Company is negotiating with IBEW linemen and office workers.

New managers of new departments in GE's Electric Utility Sales Operation are J. J. Huether, Industry Relations; J. R. Casey, Generation, Transmission & Auxiliaries Sales; W. A. Wirene, Sales Administration & Employee Relations, and W. W. Jenkins, counsel. W. J. McLachlan is manager of Systems Engineering of Electric Utility Engineering.

Obituary . . . Thomas G. Dignan, 61, president of Boston Edison . . . W. E. Mitchell, 78, former president of Georgia Power.

WEEKLY POWER OUTPUT—UP 7.1% (Week Ending July 30), Kwhr 14,746,000,000



Per Cent Change From Previous Year

	July 16	July 23	July 30
Total U. S.	+ 3.9	+ 6.2	+ 7.1
New Eng.	+ 4.2	+ 2.1	+ 3.7
Mid. Atlan.	+ 7.0	+ 1.7	+ 1.9
Cent. Ind.	+ 1.3	+ 5.1	+ 7.2
West Cent.....	+10.3	+10.8	+ 8.2
Southeast	+ 6.0	+ 6.8	+ 4.7
South Cent.	+12.7	+ 8.2	+18.8
Rocky Mount...	+ 6.2	+ 5.7	+ 7.2
Pacific			
NW	+ 6.8	+ 5.6	+ 4.9
SW	+ 5.7	+12.9	+ 9.9

Seasonally Adjusted Index 272.3

Week Ago 269.2 Year Ago 252.2

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **Pressure for a Missouri Basin power pool** increases as a consumer utility group files plan for grid and stations **(p 28)** . . . Second Euratom reactor, a 242-Mw pressurized water design, will be built by French-Belgian utility group **(p 29)** . . . Pacific Power & Light Portland facilities may be acquired by city **(p 30)** . . . New Colorado private utility plans water and power project **(p 30).**

SPECIAL REPORT SUBSTATION DESIGN ▶ **Concern with high costs and community relations** is displacing strict engineering considerations as the major influence on substation design. Utility men are steering through the straits of increased public resistance and rising costs for new plant, labor, and maintenance. A close examination of the effects of these forces begins on **page 39.**

ENGINEERING ▶ **Computer processing paves way for improved service reliability** by automatically collecting and analyzing interruption data. SoCalEd uses the statistical data to eliminate recurring causes of outages **(p 36)** . . . Electric utility industry is a fertile field, declares a cadet engineer, viewing its advantages and challenges **(p 38)** . . . Outlook for continued large-scale use of wood poles in transmission and distribution is doubtful, Utility Pole Conference is told **(p 35).**

Politics and Public Power

Here are the preambles to both resources planks. The rest of the texts starts on p 32.

REPUBLICAN PLANK IS BRIEF, GENERAL

A strong and growing economy requires vigorous and persistent attention to wise conservation and sound development of all our resources. Teamwork between federal, state and private entities is essential and should be continued. It has resulted in sustained conservation and resource development programs on a scale unmatched in our history.

The past seven years of Republican leadership have seen the development of more power capacity, flood control, irrigation, fish and wildlife projects, recreational facilities, and associated multipurpose benefits than during any . . . Administration in history.

The proof is visible in the forests and waters of the land and in Republican initiation of and support for the upper watershed program and the Small Reclamation Projects Act. It is clear, also, in the results of continuing Administration-encouraged forest management practices which have brought, for the first time, a favorable balance between the growth and cutting of America's trees.

Our objective is for further growth, greater strength, and increased utilization in each great area of resource use and development.

A thin layer of earth, a few inches of rain, and a blanket of air makes human life possible on our planet.

Sound public policy must assure that these essential resources will be available to provide the good life for our children and future generations.

DEMOCRATS BLAME GOP FOR DELAYS

Water, timber and grazing lands, recreational areas in our parks, shores, forests and wildernesses, energy, minerals, even pure air —all are feeling the press of . . . increased demands of a rapidly growing population.

PROCUREMENT & PRODUCTS ▶ **Catalogue prices are lowered** by GE's high-voltage switchgear department, to bring them "into line" with current market levels. Utilities and competing manufacturers hail the move as realistic **(p 60)** . . . Westinghouse builds a 600-Mva, 20 to 138-kv transformer for a midwestern utility . . . Largest bushing-mounted load tap changers ever supplied by GE are featured in four 300-Mva autotransformers recently sent to Public Service Electric & Gas **(p 62)** . . . Power fuse with silvered contacts clears circuits under minimum or heavy faults without pitting or burning the contacts . . . Valve arresters in ratings from 3 to 18 kv contain silicon carbide valve elements for high thermal capacities and low discharge voltage characteristics **(p 68).**

MANAGEMENT ▶ **What's the outlook for new financing?** As the first half closed, the electric utilities had sold close to $900 million in new securities. That left them with as much more to raise by year's end. They'll be going after it in a market that's nervous and unsettled—but not necessarily ominous **(p 73).**

SELLING ▶ **Electric heating solves humidity problems** in a Milwaukee floral shop. Flowers now look better, stay fresh longer **(p 80).**

Natural resources are the birthright of all the people.

The new Democratic Administration, with the vision that built a TVA and a Grand Coulee, will develop and conserve that heritage for the use of this and future generations. We will reverse . . . policies under which . . . resources have been wasted, depleted, underdeveloped and recklessly given away.

We favor the best use of our natural resources, which generally means adoption of the multiple-purpose principle to achieve full development for . . . functions they can serve.

Water and Soil. An abundant supply of pure water is essential to our economy. This is a national problem.

Water must serve domestic, industrial and irrigation needs and inland navigation. It must provide habitat for fish and wildlife, supply the base for much outdoor recreation, and generate electricity. Water must also be controlled to prevent floods, pollution, salinity and silt.

The new Democratic Administration will develop a comprehensive national water resource policy. In cooperation with state and local governments, and interested private groups, a Democratic Administration will develop a balanced, multiple-purpose plan for each major river basin to be revised periodically to meet changing needs. We will erase the Republican slogan of "no new starts" and will begin again to build multi-purpose dams, hydroelectric facilities, flood control works, navigation facilities, and reclamation projects to meet mounting and urgent needs.

We will renew the drive to protect every acre of farm land under a soil and water conservation plan and speed up the small watershed program.

We will support and intensify the research effort to find an economical way to convert salt and brackish water. The Republicans discouraged this research, which holds untold possibilities for the whole world.

Nuclear Notes

AEC has set Aug. 24 for a public hearing on PG&E's request for a building permit for its Humboldt Bay boiling water reactor plant. The company had asked for a hearing on the earliest practicable date and is ready to begin construction as soon as it has a permit. Interest at the hearing will center on the pressure suppression system PG&E has developed.

Forty-five R&D projects costing nearly $8 million are being contracted by the US-Euratom Joint Research and Development Board. The projects, most of which are aimed at improvement of reactor components, will be carried out by research institutes and industrial firms in the US and in the six Euratom lands. Reactor construction is not included.

Performance tests completed July 25 at Dresden are being evaluated. The plant has produced a net of 183 Mw plus 9 Mw for the station load with a reactor thermal power of 629 Mw.

A new process for making molded graphite reduces fabrication time to a small fraction of that required now. The method was developed by the Armour Research Foundation under an AEC contract and holds promise for reducing the costs of gas-cooled reactors. Laboratory specimens that formerly required two weeks to turn out, were finished in two hours with the new process.

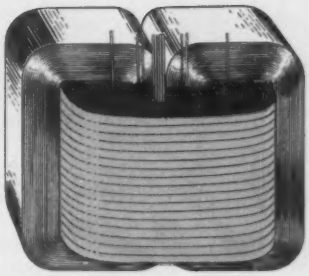
Euratom has moved into a nuclear research center at Ispra in northern Italy. The Italian government is already studying nuclear physics and reactor engineering here. Euratom will spend $40 million for new installations and will expand the current program. The international European atomic organization is also setting up research centers at Mol, Belgium, Karlsruhe, West Germany, and Petten, the Netherlands.

KEWB, Atomics International test reactor, has produced 2,300 tMw in a 5-millisec pulse. The reactor vessel of the kinetic-experiment unit is smaller than most household water heaters.

Competitive nuclear plants will be as big as present fossil-fueled plants, according to Charles H. Weaver, Westinghouse vice president for atomic power products. His company has contracts for the two biggest nuclear plants outside the British Isles. These are the 360-Mw plant for Southern California Edison and the 240-Mw SENA plant at Chooz, France (see page 29).

"Status Report on Fast Reactors as of 1959," one of the current AEC series on several types of reactors, is procurable from the Government Printing Office for $1.00.

L-M transformers exclusively incorporate a core-type core-and-coil design, designated Round-Wound®. It is a continuously wound single core with coils wound directly on each leg. This exclusive design, illustrated by the color area, permits oil ducts to be concentric about the entire winding. Maximum winding area is exposed to oil for rapid and efficient cooling. For any given loading, Round-Wound transformers have considerably lower hottest-spot temperatures and therefore greater life expectancy.



Every major manufacturer of competitive transformers utilizes a shell-type core-and-coil design. Oil ducts, illustrated by color area, can not be placed in the portion of winding under the cores. Heat is trapped and hottest-spot temperatures build up. Circulating oil can not get to these spots to carry the heat away. Result: oil stays fairly cool, while windings sizzle. Insulation deteriorates most rapidly in these areas, with an appreciable reduction in transformer life.

Uprate L-M Round-Wound® Transformers Without Any Loss of Life Expectancy

All L-M Round-Wound transformers, serial number 1,700,000 or above (serial number 7,006,650, Visalia, California production), can be safely uprated. This uprating applies to transformers now in service or in your stocks. It includes all L-M transformers produced within the last 2½ years. Only L-M can safely offer this unprecedented uprating because of the exceptional cooling characteristics of the Round-Wound core-coil construction. You get the following bonus uprating on Round-Wound transformers:

20% bonus: 5-15 kva, through 16,340 volts
20% bonus: 25 kva, through 8,000 volts
12% bonus: 25 kva, 12,000 through 16,340 volts
12% bonus: 37½-100 kva, through 16,340 volts
5% bonus: 167 kva, through 16,340 volts

Increased transformer loading and decreased transformer life expectancy are closely related. As over-loading increases, transformer insulation breaks down, jeopardizing transformer life expectancy.

Average winding temperature can be partly indicative of the damaging effects loading has upon transformers. Hottest-spot temperature, however, the maximum temperature within a transformer winding, is the one sure indicator of potential winding failure. If the hottest-spot or maximum winding temperatures are held within safe limits, winding insulation is not jeopardized and normal transformer life expectancy is maintained.

Only the Line Material exclusive Round-Wound design can effectively cool the entire winding, eliminating extreme hottest-spots. Round-Wound core and coils have concentric cooling. The oil is free to circulate through the entire winding. There are no cramped areas, no extreme hottest-spots in Round-Wound design. That is why Round-Wound transformers, without re-design, can confidently be uprated —higher than any competitive design.

You can uprate Round-Wounds without exceeding the present ASA-NEMA standard of 65°C allowable maximum rise in winding hottest-spot temperature. And the uprated transformers carry the full L-M transformer guarantee.

The present design of Round-Wound transformers have been in production for over two years. Thus, the Round-Wounds on your system, in your warehouse, as well as those you buy tomorrow, have bonus capacity and may be confidently uprated.

See your L-M Field Engineer. Let him present all the logical evidence. Then . . . YOU BE THE JUDGE.

You BE THE JUDGE!

- This is one of a series of advertisements in which Line Material is presenting facts on distribution transformers.
- In other advertisements, and through calls by our Field Engineers, L-M will present additional evidence for your consideration.
- All we ask is that you listen to the facts, and weigh the evidence.
- Then YOU BE THE JUDGE of the real values in distribution transformers.

LINE MATERIAL® Industries Transformers
McGRAW-EDISON COMPANY

476

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS
LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS
OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

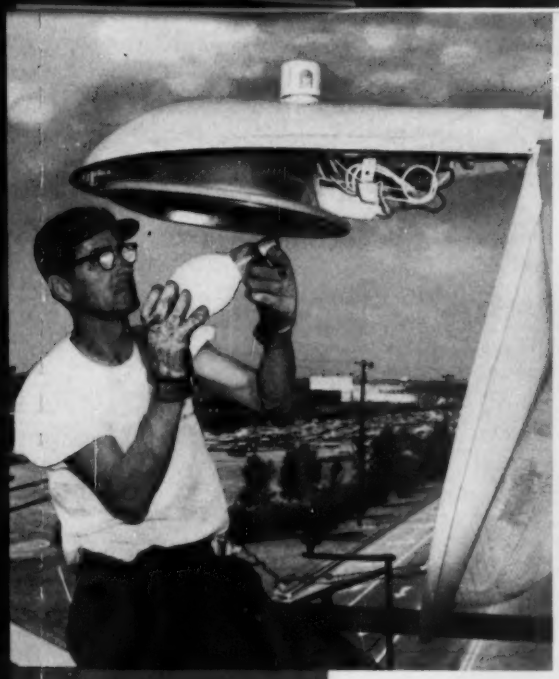
McGRAW EDISON

Cleveland Electric Illuminating Co. headquarters, the modern Illuminating Building on Public Square.

FISHER-PIERCE INDIVIDUAL-LAMP CONTROLS REDUCE CONVERSION COSTS, CLEAN UP SERVICE POLES IN CLEVELAND

Suburban Clevelanders are seeing more and more individual lamp controls on their streetlights, including Fisher-Pierce Series 6600A Controls, as The Cleveland Electric Illuminating Co. voltage conversion program continues through its second year. CEI found that modernizing the streetlighting system by changing to individual photoelectric control is a natural and highly practical part of distribution conversion. It eliminates the need for constant current transformers, oil switches and time switches, plus extra wire, insulators and hardware for streetlighting circuits, and new crossarms to isolate them from distribution lines. Conversion requires only connecting the streetlight into existing 120-volt secondary lines, replacing the lamp and installing a hood that meets EEI-NEMA standards — Fisher-Pierce controls also conform to the standard.

The new installation may be checked quickly, because of the short time delay in the controls. IL transformers, oil switches, time switches, constant current transformers and series wire can be removed, simplifying future pole work and improving neighborhood appearance. All of this in addition to dependable, automatic switching of streetlights, with light provided whenever it is needed.

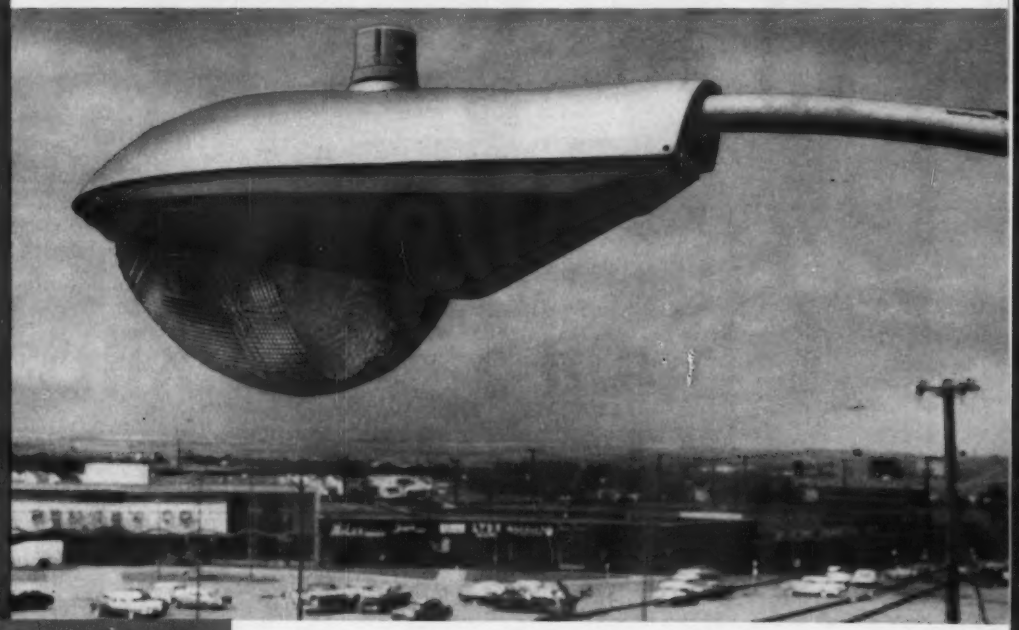


Easy calibration of F-P and other controls, using the Fisher-Pierce Series 6100 Calibrator. As the operator gradually varies the light intensity, a front-panel light indicates control operation and a foot-candle meter shows the operate value. CEI finds the Calibrator useful, particularly for acceptance testing and checking controls after repairs.

Short time delay in Fisher-Pierce Model 6600A control speeds up checking of new mercury vapor lamp (above). CEI reduces outage calls by replacing groups of lamps after a set number of burning hours.

Opening of new Southgate Shopping Center (right) reflects rapid growth in the territory vigorously promoted by Cleveland Electric Illuminating Co. as "The Best Location in the Nation"

Fast checking of a new F-P controlled installation (below) by covering the control with a homemade light shield. The short time delay in Fisher-Pierce Controls effectively prevents false turn-off by lightning—no cases have been reported to CEI.



For complete design information and specifications on Series 6600A controls and the Series 6100 Calibrator, write The Fisher-Pierce Co., 82 Pearl Street, So. Braintree 85, Massachusetts.

FP

FISHER PIERCE

PHOTOELECTRIC LIGHTING CONTROLS

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

Good Job, Jenkins!

Now if we could just make it perform like Lapp's...

Lapp Line Posts and Station Posts aren't too hard to copy, we've noticed. In looks, that is. Like most sound designs, they're refined to the ultimate in functional simplicity.

As for performance, maybe that is only a matter of time. In just 30 years Lapp has developed them from original design, through failure-free performance on problem lines and stations, to the stage where many power companies specify them exclusively.

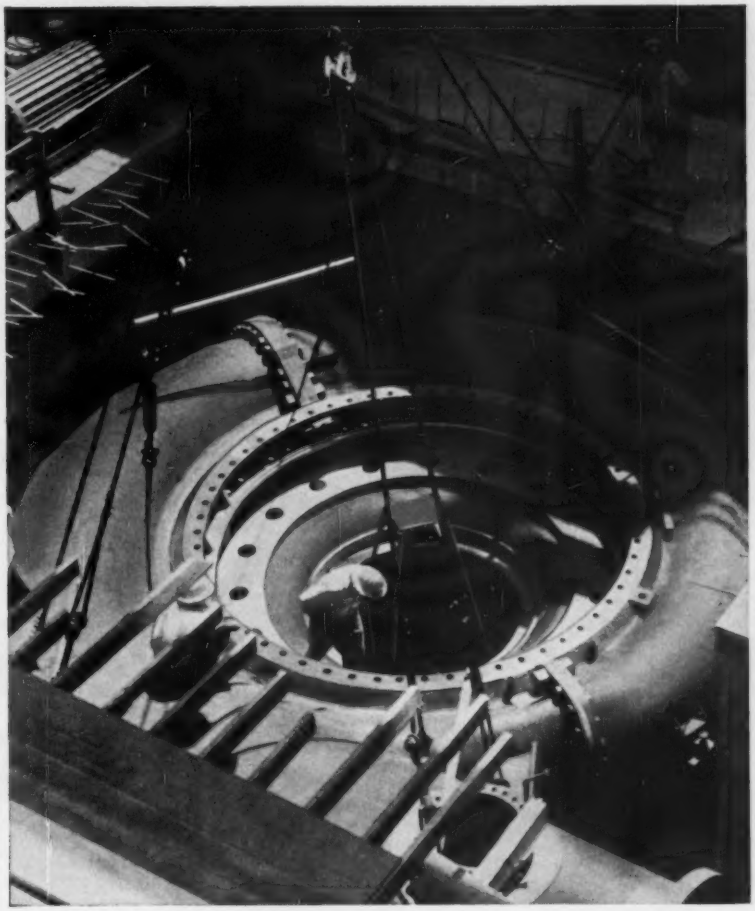
Given the right combination of design engineering, ceramic technology, and day-after-day experience in product refinement and improvement, why, in another 30 years . . .

But *today* is when you could be reducing service interruptions, cutting maintenance and replacement costs, with Lapp Line Posts and Station Posts. Find out now about this better insulator design, from the company that pioneered, proved and perfected it.

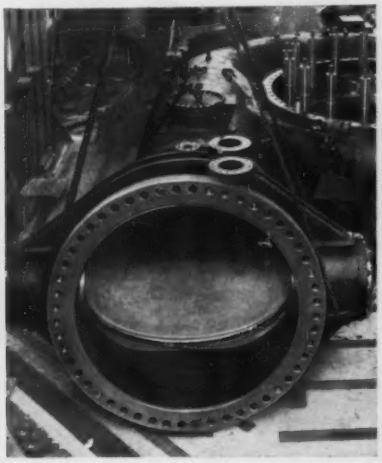
Lapp

Write for new Lapp Catalog Eight —tells all about Line Posts and Station Posts. Lapp Insulator Co., Inc., Le Roy, New York.

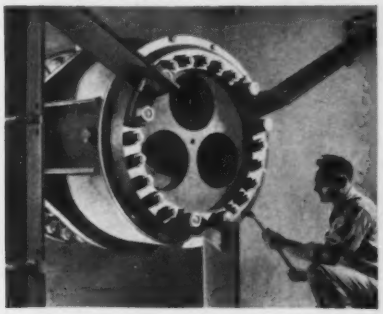
ALLIS-CHALMERS



Spiral case for one of the two A-C Francis turbines at Mammoth Pool (each rated 88,000 hp under 950-ft head at 360 rpm).



Butterfly-type turbine inlet valves—designed for minimum head loss, are bolted directly to 69 inch diameter spiral case inlet flange.



HOWELL-BUNGER valve for pressure relief — one of two 36-inch Allis-Chalmers pressure-regulator valves at Mammoth Pool, in operation under heads exceeding 1000 feet.

Peaking capacity using high-head hydro

...boosts coast utility hydro past the million-kw mark

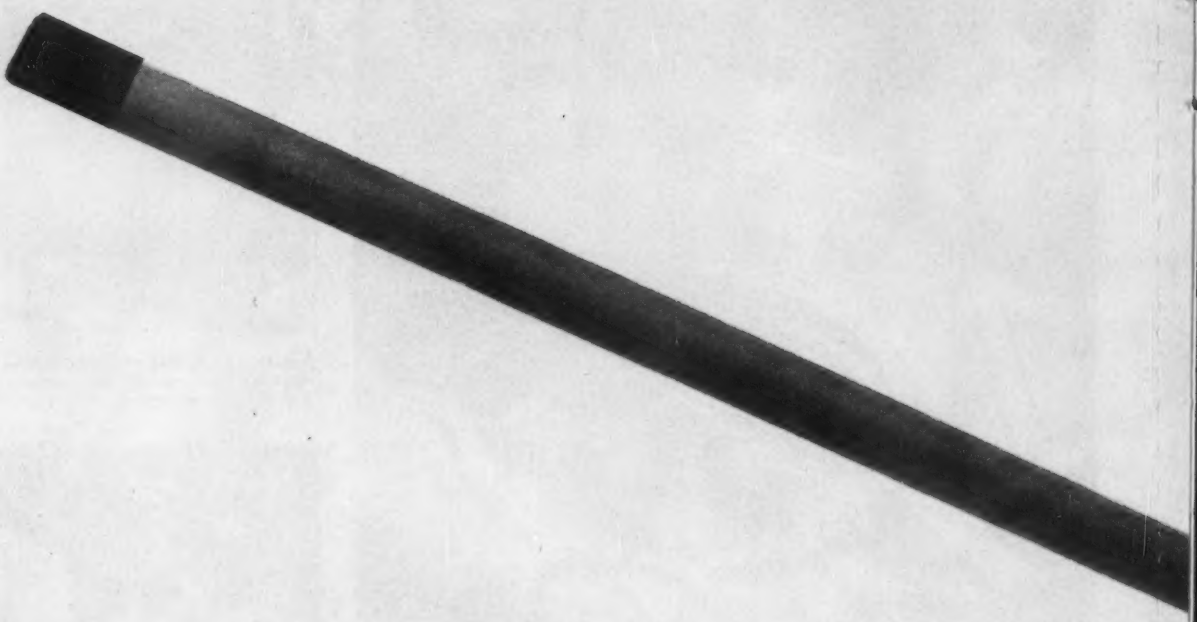
Two Allis-Chalmers hydraulic turbines installed by Southern California Edison Company at the new Mammoth Pool project operate under a maximum gross head of 1100 feet. After careful consideration of the relative merits of Francis and impulse-type turbines, the Francis type was selected for this high-head installation. Operation of these units as "spinning reserve" required special care in design and manufacture to minimize leakage losses.

Corrosion-resistant wearing plates and gates are precision machined to permit total gate end clearances at assembly of minus nothing to plus 3/1000 of an inch.

Cooling water is piped to the runner seal rings and a complete tailwater depressing system was included by A-C. To facilitate 10-second load rejection and maintenance of minimum downstream flows, A-C supplied two *Howell-Bunger*, free-discharge type, pressure-regulating valves. Two special high head 90-inch butterfly-type inlet valves are provided with corrosion-resistant seals and seat rings adjustable from the outside. A 60-inch *Howell-Bunger* valve and a 72-inch butterfly guard valve are in the reservoir dam outlet works for water release when required.

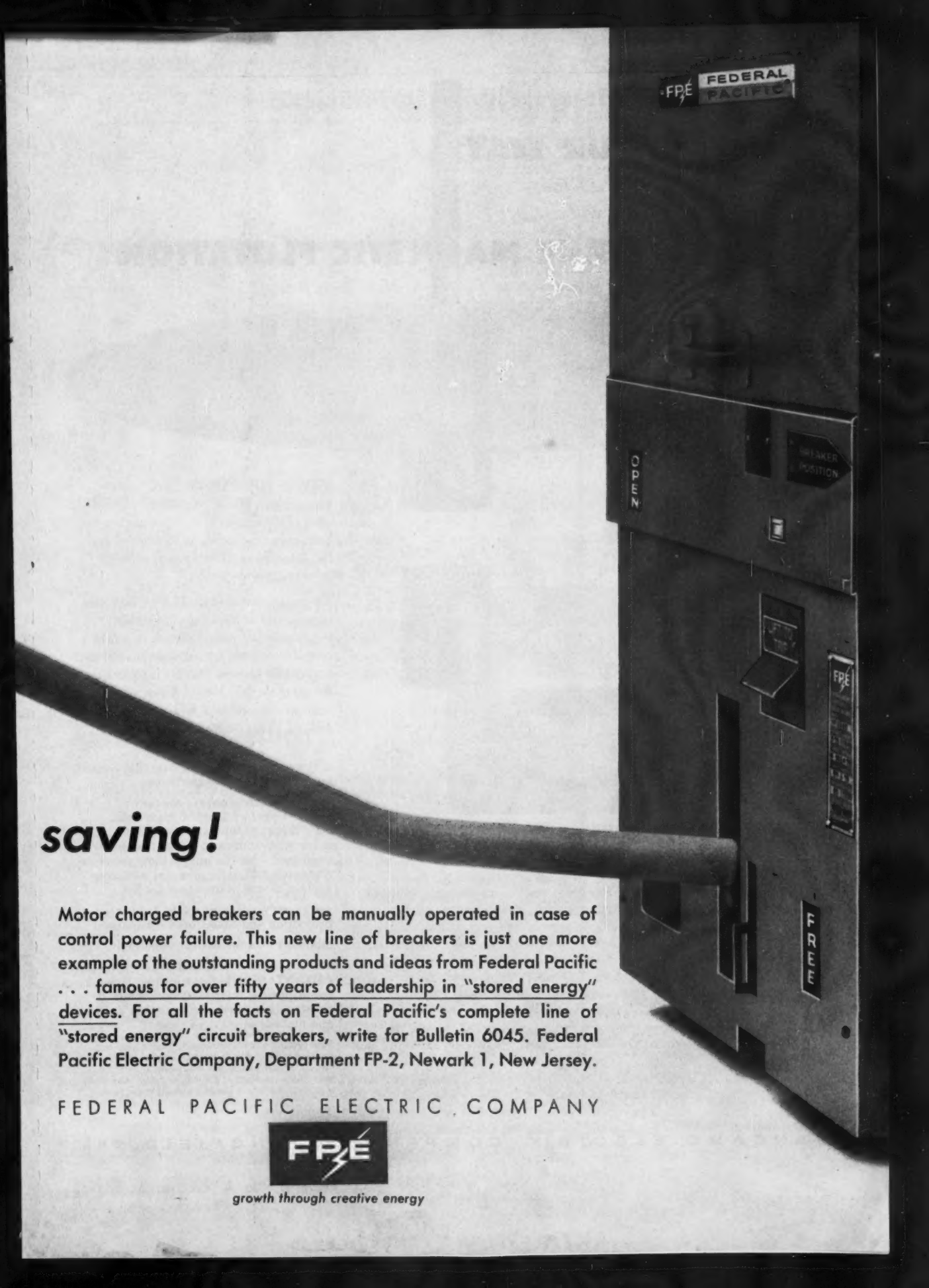
Look to Allis-Chalmers for engineering, design and manufacture of hydraulic turbines and accessories. *Contact your local A-C office for information or write* **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1333

Howell-Bunger is an Allis-Chalmers trademark.



the handle to a $5200

Just one stroke of the handle stores the closing energy in the new and unique Federal Pacific 5 KV and 15 KV circuit breakers. By eliminating outside power sources, the new breakers cut installation costs up to $5200 on battery, cable and control requirements alone. And "stored energy" is *safe* energy with Federal Pacific breakers . . . even for inexperienced operators! Our exclusive foolproof interlock prevents actuation unless instrument door is *closed and locked.* Also available . . . electric motor charged "stored energy" breakers . . . for new economy and reliability in unattended installations.



saving!

Motor charged breakers can be manually operated in case of control power failure. This new line of breakers is just one more example of the outstanding products and ideas from Federal Pacific . . . famous for over fifty years of leadership in "stored energy" devices. For all the facts on Federal Pacific's complete line of "stored energy" circuit breakers, write for Bulletin 6045. Federal Pacific Electric Company, Department FP-2, Newark 1, New Jersey.

FEDERAL PACIFIC ELECTRIC COMPANY

FPE

growth through creative energy

COMING YOUR WAY

the Sangamo J3, the only meter with.....

TRUE MAGNETIC FLOTATION

THIS IS THE ONE, developed to meet your needs... THE SANGAMO SINGLEPHASE J3 WATTHOUR METER. This is the new and noteworthy development in watthour meters this year. One of the exceptional advances in metering in any year!

The moving system of the J3 is not supported or suspended. It floats, pure and simple, permanently and without friction, on a field created by magnets that are dimensionally and magnetically uniform. Stability is assured by the use of specially bonded Alnico in *all* magnetic components of the system.
And, the J3 has these other *new* features:

A VISIBLE, SELF-CLEANING GAP that cannot be bridged by metal particles.

A CONTROLLED FLOATING SYSTEM for best performance on high loads. Side thrust is substantially reduced; tilt error is insignificant. These features combined with the unique slow speed of Sangamo J Meters, give you a moving system that is *guaranteed for life.*

ADVANCED INSULATION LEVEL for better protection and easier heat dissipation.

SMALLEST SIZE for easiest handling.

PLUS THESE TRADITIONAL SANGAMO ADVANTAGES: highest torque; slowest speed; lowest watt loss; sectionalized construction; corrosion-resistant finishes and materials; glaskyd base.

Your Sangamo Representative is coming your way with a sample of the J3. Become familiar with its "pluses". Then, plan to put it to work... for it has everything you want in a watthour meter. And that's a promise, for this is one of the really great ones.

JM60-4

true *MAGNETIC* flotation

J3

SANGAMO ELECTRIC COMPANY / SPRINGFIELD, ILL.

Editorial Comment

AUGUST 8, 1960

Other Lands and Other Ideas

Both newly elected top officers of the Canadian Electrical Assn—the general counterpart of our Edison Electric Institute—represent "public power" groups (see p 34). Their election took place only a year after CEA admitted non-investor-owned utilities to membership.

It would be easy to characterize this event as a "take-over" of an important association. It is equally easy to note gloomily that most world power outside the US is "public power." But these easy evaluations can avail us little.

Each country has its peculiar circumstances, ground rules, and philosophies. In the US, most of us are proud that investor-owned utilities are willing and able to serve the nation's power efficiently. In other lands, for various reasons, the citizenry may deem it right and proper for governmental agencies to perform this function, in whole or in major part.

While we may disagree with the choices some other nations have made, it is imperative that we understand the background of their choices before we speak out. Otherwise, it would be presumptuous and undiplomatic on our part to criticize them openly. Think of our outraged sensibilities should some uninformed person from beyond our borders dare to charge publicly that US investor groups have no basic right to serve power!

And there's a more practical consequence of bearing ill will toward government power groups outside the US. If we reject them for what we may consider the taint of their ideology, we may reject almost all the engineering and operating know-how they possess.

And as EW's editors touring Europe, the UK and Canada are discovering, this could be a serious loss indeed.

Ask a Silly Question . . .

Exactly what is a "preference customer"?

Generally speaking, we thought we knew. And, generally speaking, we thought our civil servants did, too. But an item in a recent *New Yorker* issue seems to throw some doubt on this point, and we're led to wonder whether we too shouldn't be confused.

According to the *New Yorker,* a citizen requested the definition from the Department of Interior (branch or bureau unspecified). The hapless fellow received this classic reply, carefully couched in actively passive officialese:

> *"The broad question of preference customer qualification is one which is not well suited to discussion in generalities and on the basis of hypothetical considerations. Unfortunately, when discussing such a subject in general and hypothetical terms, either question or response is apt to give a misleading impression because one or another theoretical or hypothetical factor may be singled out for emphasis and the subject is then prone to be viewed against a set of limited conditions and qualifications which may have little relationship to actual facts and circumstances as they develop and in the light of which the particular status in fact of a given customer will ultimately have to be determined."*

We can't resist wondering whether the proximity of the elections had anything to do with this magnificent evasion of an innocent request for information. If so, perhaps Interior has decided to hibernate until November.

PS: *Electrical World* is seeking an additional editor. We know one place we can't afford to look.

Missouri Power Pool Plan Filed

No investor-owned utilities are included in the new master plan for a Missouri Basin power pool submitted to USBR

New pressures for a Missouri Basin power pool were created in mid-July when an organization called the Mid-West Electric Consumers Assn (composed of co-ops and municipal systems) filed a proposal with the US Bureau of Reclamation.

Federal and Non-Profit Financing

The plan calls for federal and non-profit construction of a 345-kv transmission grid, several large thermal generating plants, and eventually a 500-kv tie with Bonneville Power Administration. Cost of the plants, transmission grid and tie is estimated at $295 million, and construction would be scheduled to take place over the next 15 years.

President of the group is Charles H. Mahoney of Jordon, Mont., and its executive manager is Ken Holum of Aberdeen, S. D. A power supply committee has been set up by the organization. It is comprised of eight men—one each from NRECA, REA, Stanley Engineering, R. W. Beck & Associates, and five area co-ops. This committee compiled the new report which calls for the following developments, year by year:

1965—Construction of a 200,-000-kw lignite thermal plant near Garrison Dam, N. D., plus a tie-in of the Nebraska Systems ($37.8 million).

1967—Construction of a 200,-000-kw lignite or nuclear power plant near Vermillion, S. D., ($39.8 million).

1969—Construction of a second 200,000-kw lignite plant at Garrison, N. D., plus a 345-kv line from Garrison, via Jamestown, N. D., to Watertown, S. D., ($76.9 million).

1970—Construction of a 230-kv line from Fargo, N. D., to Cohasset, Minn., ($4.7 million).

1971—Construction of two 25,-000-kw gas turbines for peaking purposes at Cohasset ($15.7 million).

1972—Construction of a third 200,000-kw lignite power plant at Garrison, plus extension of the 345-kv power line from Watertown, S. D., to Hinton, Ia., ($51.3 million).

1973—Construction of a 230-kv line from Hinton to Humboldt, Ia., ($3.1 million).

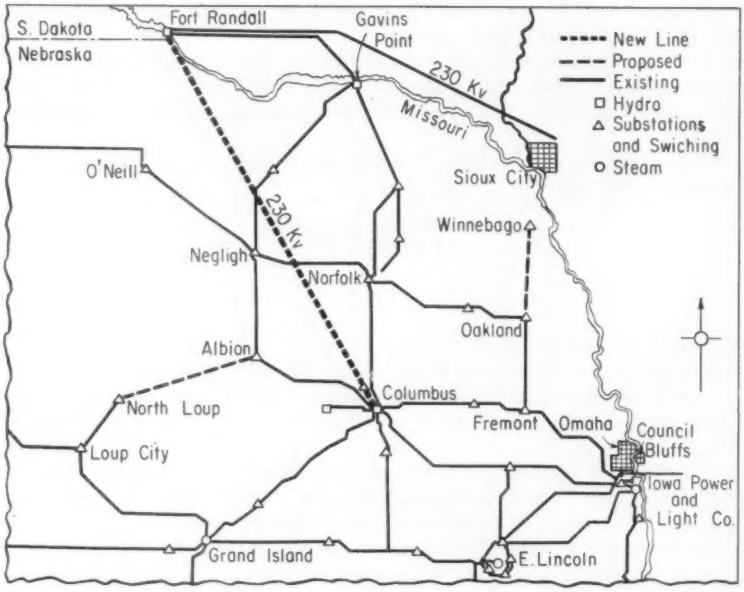
1974—Construction of a 230-kv line from Garrison, via Devils Lake, to Grand Forks, N. D., and building a 50,000-kw peaking plant by Southwestern Federated Power Cooperative at Creston, Ia., ($11.8 million).

1975—Construction of a 300,-000-kw nuclear power plant at Vermillion, next to the existing lignite or nuclear plant ($54 million). Also, after 1975, the Mid-West group calls the Missouri-Bonneville intertie "a definite possibility worthy of engineering study . . . it behooves those interested in proper basin development to see that engineering and economic studies proceed on the east-west intertie at a speed consistent with its importance."

Other Tie Lines Anticipated

Mid-West points out that interties to the east and south of the Missouri Basin also are "bound to follow." The group confined its study to the eastern area of the eastern division of the Missouri River Project. It calls for a $300,000 fund yearly to finance its own power pool office—including a general manager, five engineers (one each from the Corps of Engineers and the Bureau of Reclamation) and the necessary clerical staffs.

Financing of the project, aside from federal appropriations would be divided between co-op and mu-



Nebraska Dedicates Missouri Power Tie

Nebraska's first 230-kv transmission line is now in service carrying power from Ft. Randall Dam, S.D., on the Missouri River to Columbus, Neb. The line is owned by the Nebraska Electric Generation & Transmission Cooperative, Inc, an organization of 22 rural public power districts and cooperatives.

The line will carry Missouri Basin firm power for summer irrigation pumping and air conditioning loads which have created a relatively high summer peak in Nebraska.

nicipal systems: 25-50% (peaking facilities) by municipals; 50-75% (first stage firm power generation) by co-ops. This breakdown would be necessary, says Mid-West because of the difficulty in combining REA loans and municipal funds for joint facilities.

The net effect of the Mid-West group's plans would be assured firm power to preference customers in the area almost indefinitely. In addition to the new generating plants, the plans would give the Bureau a series of 345-kv lines: from Sheridan to Garrison Dam, from Garrison to Cohasset, from Garrison to Hinton, from Garrison to Granite Falls, Minn., from Hinton to Gering, Neb., from Gering to the Denver load center, and from Gering back to Sheridan. The 500-kv line to Bonneville would run from Sheridan to a "substantial" point on the West Coast federal system.

Big USBR System Already Exists

The Bureau of Reclamation presently operates a little over 10,000 miles of high-voltage transmission lines in the area, and it expects to have about 11,000 miles in service in the next few years. It is pushing for completion of all power generating plants at the six federal mainstem dams along the Missouri—an ultimate capacity of 2,048, 000 kw. These are: Oahe, S. D., 595,000 kw; Big Bend, S. D., 468,000 kw; Garrison, N. D., 400,000 kw; Fort Randall, S. D., 320,000 kw; Fort Peck, Mont., 165,000 kw; Gavins Point, S. D.-Nebr., 100,000 kw.

Co-op generating capacity is expected to total about 300,000 kw in the next few years; municipal systems will add another 775,000 kw; and the Nebraska and Omaha systems should add still another 1.3-million kw. All the rest of the power in the basin comes from private power companies.

The Bureau presently has no plans to build thermal generating plants in the basin, or to interconnect the basin with Bonneville, says Assistant Reclamation Commissioner N. B. Bennett. Speaking before the Tongue River Electric Cooperative, Mont., in July, Bennett said the Bureau would start studies of a power pool this fall, but that such studies probably wouldn't bear fruit until about 1963, which is short of the Mid-West starting time.

Second Euratom Plant Is PWR

The second and largest nuclear plant in the US-Euratom program, a 242-Mw pressurized-water plant, has been announced by a French-Belgian utility group, the Societé d'Energie Nucleaire Franco-Belge des Ardennes (SENA). Contract for the new plant has been awarded to Westinghouse Electric Corp and two European associates, Framatome (France) and Ateliers des Construction Electriques de Charleroi (Belgium). Gibbs and Hill of New York will be architect-engineers.

SENA said the closed cycle pressurized water type was selected to give the Euratom program broader scope. The Italian SENA reactor, announced earlier, is a boiling water design. The German AKS group is studying an organic moderated plant.

Electricité de France and the Centre-Sud combine of Belgium, representing almost all the Belgium utilities, are equal partners in the SENA Ardennes reactor.

Although recent increases in supplies of fossil fuels have made the need for nuclear power much less pressing in Europe, some far-thinking utilities have launched nuclear power programs as much to build up technical knowhow as to get kilowatts. One EDF executive says, "We are quite frankly buying know-how for the future with EDF-1 and probably with EDF-2 also," two earlier nuclear plants.

The SENA contract is subject to three main contingencies: adequate insurance; satisfactory fuel arrangements with the US; and arranging financing with the Belgian partners. The deadline for solution of these problems was set for Dec. 31, 1960.

Spokesmen for Electricité de France, the French utility system, said chances of clearing up all contingencies before the deadline and starting reactor construction in early 1961 looked good. France, Belgium, and several other countries are expected to sign the third-party liability convention soon, paving the way for insurance coverage. For all practical purposes, the agreement frees suppliers from any liability for damages caused by a nuclear accident. Maximum liability to operators of nuclear power plants will be $15 million.

The Belgian government has promised financial aid to the Belgian partners of Electricité de France for the new nuclear plant. For fuel, SENA wants lease terms similar to those the AEC gives American reactor operators.

The contracts call for a 210-Mw electrical output for the first fuel charge and 242 Mw for subsequent charges. Although the amount of the contract was not announced, Electricité de France indicated that US sources would supply 24% of the materials and services involved, with the French and Belgian sources splitting the remainder.

Scheduled for operation in 1965, the SENA plant will be the largest single-reactor plant in Europe using enriched radium and the second largest in the free world.

California PUC Attacks Ad Expense

The question of allowable expenses for rate-making is before the California Public Utilities Commission again, after hearings in Los Angeles last month concerning rate increases sought by Southern California Gas Co and Southern Counties Gas Co, subsidiaries of Pacific Lighting Corp, San Francisco.

Victor M. Martin, staff engineer for the PUC, has recommended that the companies slash some $2.5 million from their proposed annual advertising and sales promotion budgets, as far as rate-making is concerned. The companies estimated their combined budgets for such promotion at $10 million for a test year ending June 30, 1961. The PUC witness pointed out that the utilities are free to spend whatever they like for promotion, but that stockholders should pay whatever exceeds the PUC estimate.

While the two utilities are the only suppliers of gas in their service areas, they compete with electric utilities and electrical dealers.

The PUC has complaints from gas appliance dealers claiming they cannot compete with the two utilities on price or customer service.

Portland Eyes PP&L Properties in City

Portland's Mayor Terry D. Schrunk has requested a study of feasibility of city purchase of facilities in Portland of Pacific Power & Light Co.

Proposal for the city purchase was made by United Business Associates, Inc, a group which has frequently testified for public power in various hearings.

Basis of the proposal is a purchase option clause in PP&L's franchise. The utility serves about 40% of Portland, the balance being served by Portland General Electric Co. There is no purchase option in the PGE franchise.

Mayor Schrunk requested Mark A. Grayson, commissioner of public utilities, and Ormond R. Bean, commissioner of finance, and the city attorney's office to study the proposal and make a recommendation to the Portland city council.

Max R. Martin, an electrical engineer who appeared with Del Bucknum, president of UBA, at the City Hall, estimated PP&L properties in Portland might cost from $35 to $50 million.

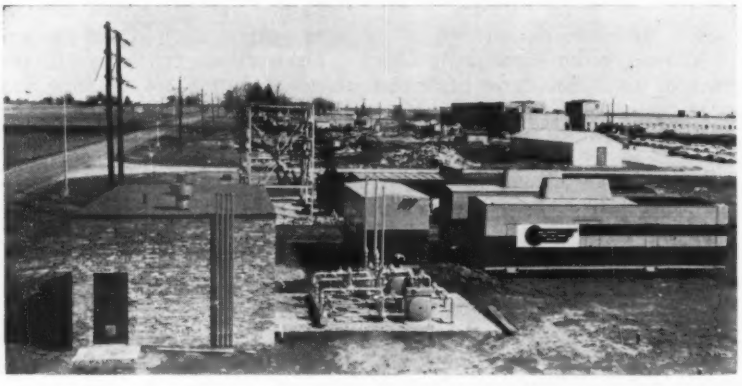
Bucknum contended PP&L purchases its power from Bonneville Power Administration for rates comparable to other utilities, yet charges much higher rates to the consumer. He said that residential rates in Portland average 10 to 30% higher than in other cities from Eugene to Seattle and commercial rates are 40% above the average. D. R. McClung, president of PP&L, said electric rates in Portland are among the lowest in the nation.

"The council's study should reveal clearly the overall benefits of the city continuing to receive electric service from tax-paying utilities that pay their own way and are limited to a reasonable rate of return under state regulations," said McClung.

"The study will show that our Portland franchise is bringing the city $226,000 a year in franchise revenue.

"This amount is over and above the $971,000 a year we are now paying in real and personal property taxes in Portland and Multnomah County. Every taxpayer in the community should be alarmed at any proposal to take these properties off the tax rolls in these times."

McClung noted that PP&L has carried on more than $192 million worth of new construction in this area in the past five years, including power developments.



Dual Fuel Plant Serves Dual Purpose

Emergency power for a new $17-million research laboratory near Ames, Iowa, and peaking power for the Ames area will be supplied by a 2,000-kw, dual-fuel, diesel-electric power plant installed by Iowa Electric Light & Power Co. These two functions were announced during the recent dedication of the plant, which is on the site of the Department of Agriculture's Animal Disease Research Laboratory.

Selection of the power plant, which was built by Electro-Motive Division of General Motors Corp, was based on the need for a highly reliable source of power for 1,800 kw of the projected 4,000-kw load at the laboratory. The facility is served by two 34.5-kv lines plus the remote-controlled, automatic-startup plant. In the event of an outage of the "normal" 34.5-kv line, the diesel-electric unit will wait 30 sec, then start and come up to speed automatically. If the "standby" line does not pick up the load, the unit then will carry the 1,800-kw "preferred" laboratory load.

For peaking use, the unit will be controlled over a leased line circuit from an Iowa EL&P power station in Boone, 20 miles away. The dual-fuel plant normally will burn natural gas, but will automatically switch to diesel fuel upon low pressure or loss of gas or when it is in emergency operation.

New Utility in Colorado

A new privately-owned electricity and water utility has plans for development of Colorado's Sweetwater Creek and other tributaries of the Colorado River. Called the Rocky Mountain Power Co, the utility was organized by the engineering firm of Van Sickle Associates, Inc, Denver.

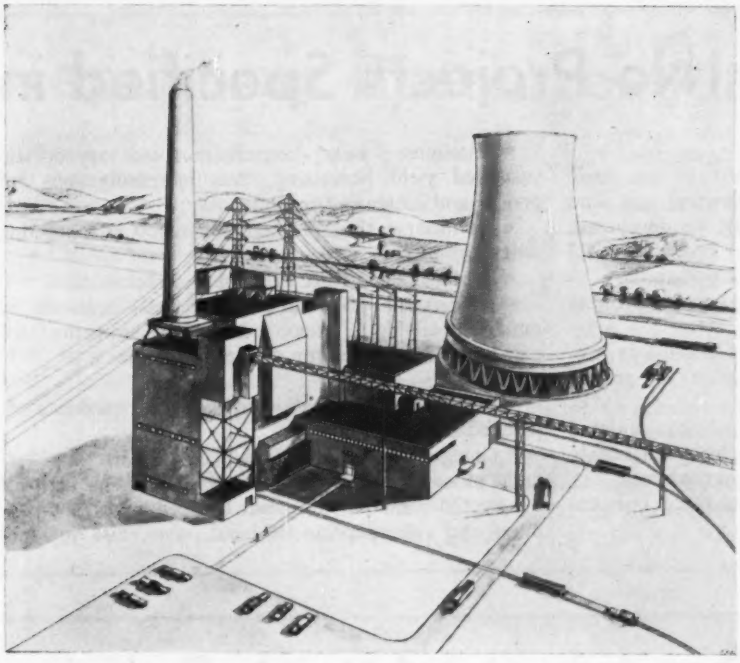
Its plan for the project is filed with the State Engineer in Denver.

Also in the plan is diversion of water from the South Fork of the White River northeast of Glenwood Springs.

Plans call for construction of two generating plants with a combined capacity of 56,000 kw.

Paul G. Van Sickle, who heads up the engineering firm and the new utility, declined to comment on plans for marketing the power and water from the project. Van Sickle's chief engineer, M. J. Greer, said the project "is very feasible." He said the company could produce power and "compete very easily" with power to be produced by the Colorado River Storage Project.

The company has included plans for a 50-mile pipeline to deliver water to oil shale development areas near Rifle and Grand Valley. This phase of the project would cost about $10.7 million. The power producing portion would cost about $27 million.



Sheaf-of-wheat tower is first in US as Kentucky Power . . .

Tries European Cooling Method

The first "sheaf-of-wheat" cooling tower in the western hemisphere will be built at Kentucky Power's new Big Sandy Plant near Louisa, Ky. The tower will provide additional cooling capacity to supplement the limited flow of the Big Sandy River, particularly during periods of low flow.

Construction of the tower is expected to start this fall and will take an estimated 18 months. Ground for the $39-million, 275-Mw Big Sandy Plant itself was broken last week. It is scheduled to be completed late in 1961.

The "sheaf-of-wheat" or Mouchel design, long popular abroad, was selected after a two-year study by American Electric Power Service Corp engineers, who designed Big Sandy. Although a series of cooling towers—four in existence and two planned—is used at Appalachian Power Co's Clinch River Plant, these towers were box-shaped and used fans for cooling.

Instead of fans, the Big Sandy tower will use a natural draft of air or chimney effect. It will provide the 265-Mw plant with 120,000 gal per min of cool water, dissipating over one and one-third Btu per hr. Eliminating the 15 100-hp fans that would have been needed for a conventional cooling tower produced a saving of more than $250,000 in plant capacity and fuel.

Hot circulating water coming from the plant's condenser will be pumped into the tower at a level 40 ft above its base, then fall through wooden packing. Heavy masses of air, drawn up by the draft action of the tower, will evaporate a small portion of the hot water and cool the remainder.

Rising 320 ft above the ground, the hyperbolic-shaped tower will have a 245-ft dia at the base and narrow to 130 ft just below the top, and then widen again to 140 ft. To provide an entrance for the huge amount of cooling air required, the lower 10 ft of the tower will be open, except for the concrete columns on which the tower rests.

Contract for construction of the tower was awarded to The Marley Co of Kansas City, Mo., who also built the Clinch River Plant towers.

Rep Moss Asks New Public Power Lines in California

Rep John Moss (D-Calif.) has called for the Interior Department to enter into an agreement with three California public power systems to build new transmission lines, at discount rates, to carry federal Central Valley power. His request came on the heels of an opinion by Comptroller General Joseph Campbell that the Department now has authority to enter into a discount arrangement to finance construction of the facilities.

Said Moss: "The Comptroller General's ruling states that there is no legal difference between the Bureau granting a rate discount to a preference customer which builds its own transmission line, and the grant of a discount to a customer which puts up cash for a transmission line built by the federal government." He added that the transmission line plans of the three systems—City of Redding, City of Roseville and Shasta Area PUD—"would mean savings of millions of dollars both to the customers and to the federal government when compared to the cost of wheeling power over Pacific Gas & Electric Co facilities." Included in the three systems' plans would be a transmission line between Keswick and Toyon, Calif.

Maryland Cooperative Plans 99-Mw Steam Plant

Southern Maryland Electric Cooperative, Inc, Hughesville, Md., has asked REA for an $18,736,000 loan to build a 99-Mw steam plant at Oraville, Md., to supply its 23,500 customers. About $400,000 of the loan would be for transmission the rest for the steam plant. Southern Maryland Manager Forrest Coakley said the plant would replace power from Potomac Electric Power Co—about $1.5-million annually. The co-op is "seriously concerned" over rising power rates, he added.

No Projects Specified in

We pledge:

- Use of the community watershed as the basic natural unit through which water resource, soil, and forest management programs may best be developed, with interstate compacts encouraged to handle regional aspects without federal domination.
- Development of new water resource projects throughout the nation.
- Support of the historic policy of Congress in preserving the integrity of the several states to govern water rights.
- Continued federal support for Republican-initiated research and demonstration projects which will supply fresh water from salt and brackish water sources.
- Necessary measures for preservation of our domestic fisheries.
- Continued forestry conservation with appropriate sustained yield harvesting, thus increasing jobs for people and increasing revenue.
- To observe the "preference clause" in marketing federal power.
- Support of the basic principles of reclamation.
- Recognition of urban and industrial demands by making available to states and local governments, federal lands not needed for national programs.

Full use and preservation of our great outdoors are pledged in:

- Completion of the "Mission 66" for the improvement of national park areas as well as sponsorship of a new "Mission 76" program to encourage establishment and rehabilitation of local, state, and regional

Democrats Attack Policies

Water and air pollution. America can no longer take pure water and air for granted. Polluted rivers carry their dangers to everyone living along their courses; impure air does not respect boundaries.

Federal action is needed in planning, coordinating and helping to finance pollution control. The states and local communities cannot go it alone. Yet President Eisenhower vetoed a Democratic bill to give them more financial help in building sewage treatment plants.

A Democratic president will sign such a bill.

Democrats will step up research on pollution control, giving special attention to:

- The rapidly growing problem of air pollution from industrial plants, automobile exhausts, and other sources, and
- Disposal of chemical and radioactive wastes, some of which are now being dumped off our coasts without adequate knowledge of the potential consequences.

Outdoor recreation. As population grows and the work week shortens and transportation becomes easier and speedier, the need for outdoor recreation facilities mounts.

We must act quickly to retain public access to the oceans, gulfs, rivers, streams, lakes, and reservoirs, and their shorelines, and to reserve adequate camping and recreational areas while there is yet time. Areas near major population centers are particularly needed.

The new Democratic Administration will work to improve and extend recreation opportunities in national parks and monuments; forests; river development projects; and near metropolitan areas. Emphasis will be on attractive, low-cost facilities for all the people and on preventing undue commercialization.

The national park system is still incomplete; in particular, the few remaining suitable shorelines must be included in it. A national wilderness system should be created for areas already set aside as wildernesses. The system should be extended but only after careful consideration by the Congress of the value of areas for competing uses.

Recreational needs of the surrounding area should be given important consideration in disposing of federally owned lands.

We will protect fish and game habitats from commercial exploitation and require military installations to conform to sound conservation practices.

Energy. The Republican Administration would turn the clock back to the days before the New Deal, in an effort to divert the benefits of the great natural energy resources from all the people to a favored few. It has followed for many years a "no new starts" policy.

It has stalled atomic energy development; it has sought to cripple rural electrification.

It has closed the pilot plant on getting oil from shale.

It has harassed and hampered the TVA.

We reject this philosophy and these policies. The people are entitled to use profitably what they already own.

The Democratic Administration instead will foster the development of efficient regional giant power systems from all sources, including water, tidal, and nuclear, to supply low-cost electricity to all retail electric systems, public, private, and cooperative.

The Democratic Administration will continue to develop "yardsticks" for measuring the rates of private utility systems. This means meeting the needs of rural electric cooperatives for low-interest loans for distribution, transmission and generation facilities; federal

Republican Resources Plank

parks, to provide adequate recreational facilities for our expanding population.

• Continued support of the effort to keep our great out-of-doors beautiful, green, and clean.

• Establishment of a Citizens Board of Conservation, resource and land management experts to inventory those federal lands now set aside for a particular purpose; to study the future needs of the nation for parks, seashores, and wildlife and other recreational areas; and to study the possibility of restoring lands not needed for a federal program.

Minerals, metals, fuels also call for carefully considered actions in view of the repeated failure of Democratic-controlled Congresses to enact any long-range minerals legislation. Republicans, therefore, pledge:

• Long-range minerals and fuels planning and programming, including increased coal research.

• Assistance to mining industries in bridging the gap between peak defense demands and anticipated peacetime demands.

• Continued support for federal financial assistance and incentives under our tax laws to encourage exploration for domestic sources of minerals and metals, with reasonable depletion allowances.

To preserve our fish and wildlife heritage, we pledge:

• Legislation to authorize exchange of lands between state and federal governments to adapt programs to changing uses and habits.

• Vigorous implementation of long-range programs for fish and wildlife.

# of Republican Administration

transmission facilities, where appropriate, to provide efficient low-cost power supply; and strict enforcement of the public-preference clause in power marketing.

The Democratic Administration will support continued study and research on energy fuel resources, including new sources in wind and sun. It will push forward with the Passamaquoddy Tidal Power Project with its great promise of cheaper power and expanded prosperity for the people of New England.

We support the establishment of a national fuels policy.

The $15 billion national investment in atomic energy should be protected as a part of the public domain.

Federal lands and forests. The record of the Republican Administration in handling the public domain is one of complete lethargy. It has failed to secure the fullest present benefits. In some cases, it has given away priceless resources for plunder by private corporations, as in the Al Sarena mining incident and the secret leasing of game refuges to favored oil interests.

The new Democratic Administration will develop balanced land and forest policies suited to the needs of a growing America.

This means intensive forest management on a multiple use and sustained yield basis, reforestation of burnt-over lands, building public access roads, range reseeding and improvement, intensive work in watershed management, concern for small business operations, and insuring free public access to public lands for recreational uses.

Minerals. America uses half the minerals produced in the entire free world. Yet our mining industry is in what may be the initial phase of a serious long-term depression. Sound policy requires that we strengthen the domestic mining industry without interfering with adequate supplies of needed materials at reasonable costs.

We pledge immediate efforts toward the establishment of a realistic long range minerals policy.

The new Democratic Administration will begin intensive research on scientific prospecting for mineral deposits.

We will speed up the geologic mapping of the country, with emphasis on Alaska.

We will resume research and development work on use of low-grade mineral reserves, especially oil shale, lignites, iron ore taconite, and radioactive minerals. These efforts have been halted or cut back by the Republican Administration.

The Democratic Party favors a study of the problem of non-uniform seaward boundaries of the coastal states.

Government machinery for managing resources. Long-range programming of the nation's resources development is essential. We favor creation of a council of advisors on resources and conservation, which will evaluate and report annually upon our resource needs and progress.

We shall put budgeting for resources on a business-like basis, distinguishing between operating expense and capital investment, so that the country can have an accurate picture of the costs and returns. We propose the incremental method in determining the economic justification of our river basin programs. Charges for commercial use of public lands will be brought into line with benefits received.

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PRESENT AND FUTURE presidents of CEA, N. S. Crerar (left) of Saguenay Power Co and David Cass-Beggs of Saskatchewan Power Corp, view conference hall

Provincial Execs Win Top Posts

Elections elevate Saskatchewan, Manitoba power men to forefront of Canadian Electrical Assn after first year

David Cass-Beggs, general manager of Saskatchewan Power Corp, has been elected president of Canadian Electric Assn. Vice presidents chosen were: W. D. Fallis, general manager of Manitoba Power Commission, and H. F. Beique, vice president and general manager of Quebec Power Co. Elections took place late in June at CEA's annual meeting, held at Murray Bay, Que.

Thus, with CEA's president and a vice president elected from its ranks, public power has, in its first year of membership, moved to the forefront of Canada's 69-year-old power association.

Noting that Canadian utilities produced 103.8 billion kwhr last year and that production this year is running 13.5% higher, retiring President N. S. Crerar urged CEA members to plan additions of 2 to 3.5 million kw annually in the Sixties. He predicted rising activity before year's end and pressed the industry to adopt "a large degree of standardization in equipment and . . . voltages to maintain the lowest possible cost for service." He cited the need for "orderly groundwork now for the expansions in the next 10 or 20 years."

The public must be informed about industry's efficiency and economy, its 1.6-cent-per kwhr average selling price, and its steadying influence on Canadian economy. Public relations should be considered an investment, Crerar said.

The Canadian economy, despite its lack of discernible trends early this year, shows promise of a 6% rise in capital expenditures for the year, reported A. C. Ashforth, Toronto-Dominion Bank. Exports, led by forest and mineral products, are already one-seventh over levels of the first third of 1959. This gain will boost power consumption, employment, and income, making 1960 consistent with the predicted long-term trend of economic growth, he said.

Living standards in Canada and the US are the world's highest, largely because of electric power abundance, observed Edwin Vennard, Edison Electric Institute. This abundance at reasonable cost has encouraged economic growth, produced more goods, and created more demand for goods. Industry's growth rate has been the same in both countries—7% per year—and the probable development of at least 15 new appliances during the Sixties will help this growth, he predicted.

Growth Rates Compared

"If the day ever dawns when the Russian people can enjoy the same degree of comfort and luxury which is the common lot of North American people, the danger of world conflict will be immeasurably reduced," suggested J. S. Duncan, Hydro-Electric Power Commission of Ontario. Russia's electrical growth rate is larger than that of the US, he said, but average home utilization last year in the USSR was only 400 kwhr.

Electric appliance sales in Canada have outstripped those in the US, W. F. Wansbrough, Canadian General Electric Co, reported in a panel discussion. He credited manufacturers with building load for utilities, and pleaded for utility cooperation to combat the threat of gas competition. He urged utility action to eliminate bottlenecks in inadequate service entrances.

J. A. Page, Southern Canadian Power Co, conceded that less than half of Canada's four million wired homes have capacity for high-wattage major appliances. But he urged manufacturers, distributors, and dealers to step up their participation. He recommended that manufacturers improve appliance designs to require less service, and that dealers provide well-trained service organizations to keep their customers' appliances in good order. A successful program could spur $5 billion of major appliance sales in Canada in the Sixties, Page said.

Service becomes more difficult every year because of the growing automation of appliances, said H. C. Darroch, Moffats Ltd. This trend has outrun the capabilities of general handymen, as many new appliances require special training. He prescribed trade school courses to meet this need and thereby upgrade service standards.

A warning to complacent utilities was seen in O. E. Zwanzig's announcement that B. C. Electric Co is planning to poll customer satisfaction with appliance service. He also suggested that competition from other calls on the customer's money—such as vacation trips, cars, and boats—may be more serious than that from gas utilities and appliance dealers.

Predicts Decline in Wood Pole Use

Swing to buried distribution expected to obsolete aerial plant within 50 years. Basic research seeks to extend pole life

WARREN S. THOMPSON, Asst Professor of Forestry, Louisiana State University, Baton Rouge, La.

Continued large-scale use of wood poles in transmission and distribution is doubtful, according to Fred M. Fister, Southern Bell T&T Co. He told the recent Utility Pole Conference at Louisiana State University's School of Forestry that the current trend in distribution systems points to eventual replacement of aerial conductors with buried distribution cables.

Attributing the trend to high maintenance cost and obsolescence of conventional facilities, Fister predicted that the communications industry will be out of the pole business in less than 50 years.

Basic information on wood structure and its relation to the performance of poles in service was presented by Don Miller, Oregon Forest Research Center. He said many problems arising in the use of wood poles are directly related to the anatomical structure of wood and to wood-moisture relations. The permeability of wood to liquids is closely related to its anatomical characteristics and of basic importance to producers and users of poles because of its effect on the quality of preservative treatments, he said.

Biotic Conditions Important

The quality of preservative treatments is also affected by the biotic conditions to which poles are exposed during seasoning, according to Dr A. F. Verrall, Southern Forest Experiment Station. He said wide variations in preservative retention are caused by the occurrence of certain mold fungi on unseasoned poles, particularly *Trichoderma viride*. Heavily molded poles adsorb excessive quantities of preservative solution when treated, but are difficult to season properly because of their tendency to maintain a high moisture content, he said.

Differences in moisture content and in the severity of mold infection among poles in a single charge cause some poles to adsorb too much preservative and others not enough. Dr Verrall indicated that the problems caused by mold infection can largely be solved by treating infected poles separately.

Adoption of improved techniques by the treating industry was cited by D. L. Davies, Koppers Co, as a forward step in insuring uniformity in pole quality. Factors of major importance in treatment, are the soundness of the wood before treatment, degree of seasoning, preservative retention, and the depth of preservative penetration, he said.

'Gauge' Method Criticised

Davies criticised the use of the "gauge" method of determining preservative treatment retention. This method, in wide-scale use in the treating industry for many years, assumes a direct relationship between the quantity of preservative in the supply tank before and after treatment and the quantity retained by the wood. Questioning the validity of this assumption, Davies recommended using the toluene-extraction method of measuring directly the amount of preservative in wood. The latter method has the added advantage that retention determinations can be repeated in case of doubt, an advantage not available to the gauge method.

Fundamentals of inspection and maintenance programs for poles in service were discussed by A. H. Hearn, American T&T Co, and Walter J. O'Neal, REA. Safety and reduced service disruption were listed as advantages to be derived from such programs.

Questioned on the timing of the initial inspection and the frequency of reinspections, Hearn observed that the incidence of early pole failure and the deterioration rate are influenced by geographical factors. Inspection programs should be geared to the biotic conditions in an area. Annual precipitation and the average length of the frost-free period are important indices of these conditions, said Hearn.

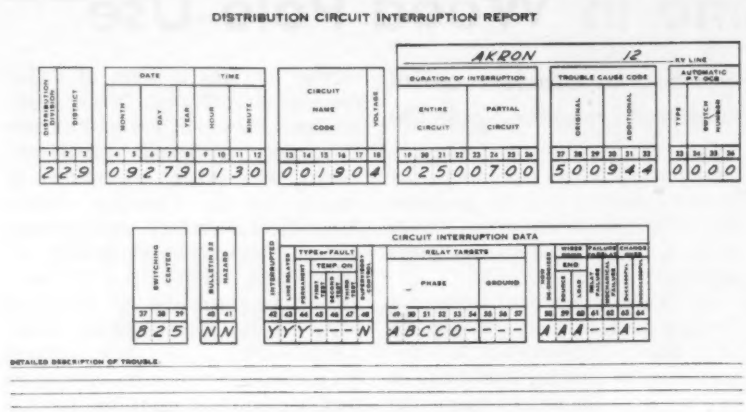
The effectiveness of groundline treatments in terms of increased service life was a point of major concern to conference participants. J. Oscar Blew, US Forest Products Laboratory, reviewed results obtained with these treatments in studies by the Canadian Forest Products Laboratory and various utility companies. According to Blew, these studies generally have shown treatment to be beneficial when applied to untreated poles. Less favorable results were reported for groundline treatments applied to freshly-creosoted stubs by the US FPL. Blew's data showed that retentions sufficient to prevent decay were largely confined to the outer half inch of test members.

J. W. Kirkland, Gulf States Utilities Co, said his company has studied the performance of ground-line treatments for several years and found them to be worth while. Calculations are based on current costs for treatment and inspection and assume that distribution poles will be treated at 15 years and again at 25 years, the latter age representing the service life used in GSU's accounting practice. These calculations prove the program to be very economical provided treatment extends pole life by 10 years, and the extension probably will more nearly approach 20 years, he said.

Illinois Utilities Seek Co-op Regulation

Illinois Power Co and Central Illinois Public Service Co have petitioned the Illinois Commerce Commission to compel a group of co-ops to comply with the state's Public Utilities Act and obtain certificates of necessity and convenience. If successful, the action would give the Illinois Commerce Commission the power to settle disputes about service to non-rural customers.

Allen Van Wyck, president of Illinois Power Co, says he does not object to co-ops serving rural customers or providing their own power plants, but does object to their serving industrial, urban, and suburban customers in territories for which his company has certificates of convenience and necessity.


DISTRIBUTION CIRCUIT INTERRUPTION REPORT

AKRON 12

DISTRICT	DATE (MONTH DAY YEAR)	TIME (HOUR MINUTE)	CIRCUIT NAME CODE	VOLTAGE	DURATION OF INTERRUPTION (ENTIRE CIRCUIT / PARTIAL CIRCUIT)	TROUBLE CAUSE CODE (ORIGINAL / ADDITIONAL)	AUTOMATIC PT. OCR (TYPE / SWITCH NUMBER)
29	09 27 9	01 30	00190	4	02500700	50 09 44	0000

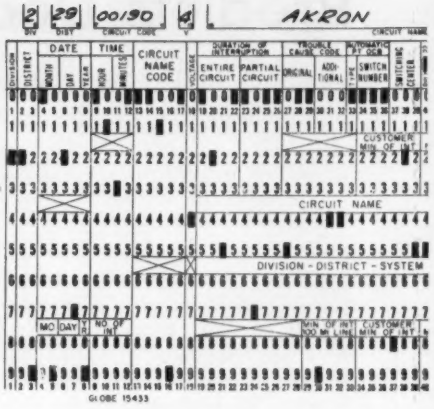
SWITCHING CENTER	BULLETIN 24 HAZARD
825	NN

CIRCUIT INTERRUPTION DATA

INTERRUPTED	TYPE OF FAULT: LINE RELATED	PERMANENT	TEMP. ON: FIRST RECLOSE	TEMP. ON: SECOND RECLOSE	TEMP. ON: THIRD RECLOSE	TEMP. ON: FOURTH RECLOSE	RELAY TARGETS: PHASE	RELAY TARGETS: GROUND	WIRES DOWN: END REMOVED	WIRES DOWN: LOAD	FAILURE OF EQUIPMENT: RELAY MISOPERATION	FAILURE OF EQUIPMENT: EQUIPMENT	CHANGE OVER: AUTOMATIC	CHANGE OVER: MANUAL	NOT INTERRUPTED
YYY	-	-	-	-	N		ABCCO	-	A	A	-	-	A	-	

DETAILED DESCRIPTION OF TROUBLE:

Distribution Circuit Interruption Report . . .



Is Key-Punched Into

Computer Processing Collects and

SoCalEd seeks to improve service reliability by automatically cataloging and reporting interruption data

M. R. MOSQUINI, Senior Distribution Engineer,

J. A. LIGHTHIPE, Operating Engineer,

Southern California Edison Co, Los Angeles, Calif.

Can a more impossible task be imagined than forecasting the location and cause of future service interruptions on a distribution system? How many interruptions should be expected and what should be their duration? How can a utility's efforts and money best be spent to cut down the duration or frequency of interruptions?

Utility people can hardly hope for a cure-all answer to these questions, but machine data processing offers a new opportunity in the drive to improve service reliability. By collecting and coding details of service interruptions, a vast store of statistical data can be made available for analyzing and devising methods of reducing the most commonly recurring causes. And the printout gives system performance by five indices as well as comparisons between operating subdivisions.

With this objective in mind, Southern California Edison Co initiated a system of automatic cataloging and reporting of interruption information. Although the system has been in operation less than a year, results so far have complemented initial expectations.

The data recording program was first established to relieve the system load dispatcher's office of considerable reporting work. In addition to daily interruption reports, the system dispatcher frequently was asked to determine the number of poles broken by autos, or the number of interruptions caused by trees or various types of weather elements —wind, snow, lightning. These reports were prepared by the time-consuming and tedious process of checking each daily report.

Code System Developed

To save time, minimize cost, and have statistical data readily available, all this information is now placed on master punch cards, including the number of customers on each line, circuit miles of line, and peak Mw figures. A code system was developed and a code number is now assigned to each distribution circuit, substation, and switching center. Many records are checked to determine the most common causes for distribution circuit interruptions and this data is used to form a Cause Code Instruction Bulletin.

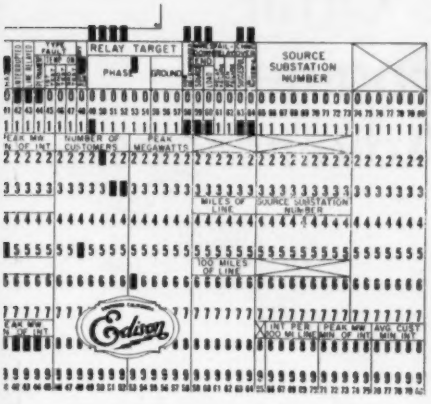
Whenever an interruption occurs, the data is recorded on a form called a "Distribution Circuit Interruption Report." Circuit identification, cause of trouble, time, date, customers affected, and other information are included.

Key-Punched Detail Card Used

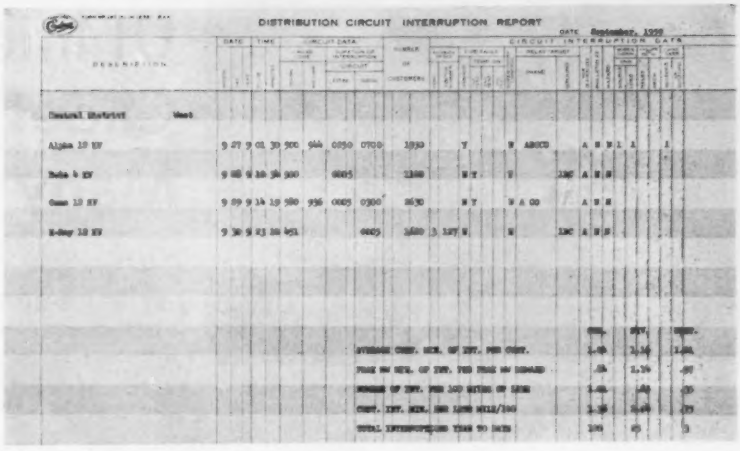
After a check by engineers in charge of the program, data is key-punched into a detail card. A punch card is prepared for each interruption of each of the system's lines, including pole-top substations carried on a distribution circuit. Whenever a multi-terminal distribution line is interrupted, only data for the line's source terminal is recorded.

The engineers elected not to record interruptions to unattended stations due to loss of a source line, if the emergency line closed immediately and picked up the load. This is considered a normal function of the changeover equipment and interruptions to customers are of but a few cycles' duration.

Maintenance of information on the master punch cards has been scheduled for revision on an annual basis, when the Distribution Division will submit a revised report on



Detail Card . . .



And Evaluated for Performance Indices

Analyzes Service Interruption Data

all distribution circuit data. At present, as each new circuit is placed in service, a punch card is prepared with the required data. More than 2,000 individual circuits at various voltages from 2.4 to 16 kv serve 1.6 million customers over an area of 19,250 sq miles.

Responsibility for operating and maintaining the distribution system is divided among four divisions and 29 districts. Because of geographic locations, weather conditions, load concentrations, and contamination, one area's problems are not necessarily comparable with another's. Establishing a standard of measurement, therefore, proved extremely difficult.

Five Indices Used in Evaluation

Several indices were used in evaluating the results of efforts to improve service reliability:

- Customer min of interruption per customer per year;
- Peak Mw min of interruption per peak Mw demand per year;
- Number of interruptions per 100 miles of line per year;
- Customer min of interruption per mile of line per year;
- Total interruptions during the last year.

These indices for the system, for the division, and for each district are made a part of the interruption reports sent to all field superintendents. As an aid in preparing the reports, punch cards are coded to be selected and sorted automatically by division, district, or switching center.

Three annual reports are expected to be issued:

- A summary of all interruptions, classified by cause, for use by distribution engineers, to check the quality of distribution construction methods and materials;
- A summary of relay reliability, for use by system engineers, for analyzing relaying practices and efficiency;
- A repeating circuit interruption report listing all circuits interrupted "X" or more times, all circuits having a total interruption time in excess of "Y" hours, or a partial interruption time in excess of "Z" hours. This report will point out areas where work is most needed to improve service reliability standards.

Special reports or tabulations of specific information may be required occasionally. These might include a review of damage and interruption time caused by a particularly severe storm, a several year review for the Safety Division of interruptions caused by crane contacts, or a comparison of the number of faults proving temporary on the first, second, or third test reclosure.

Monthly reports have been used to advantage by distribution superintendents to improve customer service. For example, if outage data indicates a large number of interruptions due to slack conductor spans blowing together in a windstorm, line design may be changed.

Service Improvements Foreseen

Not only distribution people are assisted in their work by this new program, but protection engineers, load dispatchers, and substation people also are supplied with additional useful information.

The ability to obtain data for protection engineers on operation of relays on the interrupted circuit, to keep a record on relay targets, and to keep a punch card record on causes for relay failures will be of value. The dispatcher may also check causes of circuit interruptions and the performance of automatic changeover operations at unattended stations. Substation superintendents and engineers can obtain information on the operation of substation circuit breakers and equipment.

With this large volume of statistical data available for immediate examination and study, printed in any desired sequence or form, numerous improvements in service reliability can be affected.

Utilities Offer Cadet Engineer Many Advantages

ON-THE-JOB GUIDANCE is important part of utility training program. Shown here are Author J. E. Thompson (left) with Chief System Operator C. F. Evans

JOHN E. THOMPSON, Cadet Engineer, Luzerne Electric Div, The United Gas Improvement Co, Kingston, Pa.

Every day new areas are opening in the electric utility business and new applications of equipment are being made. Certainly with today's pressures to get the best quality, more quantity, most economically with today's dollar there is a challenge to be met.

Where can a young cadet engineer, with a sincere outlook toward the future, find a better area to meet this challenge and improve his own abilities and status than in the electric power industry?

In the Navy I had served as aviation electronics technician and attended several Navy electronics schools. With this background, I entered Pennsylvania State University with the goal of majoring in electronics.

However, between my Junior and Senior years, I held a summer job with Luzerne Electric Division of The United Gas Improvement Co in Kingston, Pa. In my opinion, this was the most valuable summer of my life. Not only did the salary help me to finish my college education, but even more important, I received an insight into the electric power industry worth many times over the wages of the summer.

Upon graduation in June, 1958, I returned to Luzerne Electric and was assigned to my present position. We have no "formalized" training program, but I feel that I have learned just as much from my on-the-job training as have my fellow classmates who have gone with larger utilities having "formalized" programs.

Among my assignments to date has been the construction of a phasing diagram of the entire transmission system of the company's 66-kv and 13-kv transmission. This diagram also included the representation of all terminating points of these circuits at substations and generating plants.

A second area in which I have been active is the application of protective relays to transmission lines. This field includes a thorough workout in phasor quantities and vector mathematics and relationships not to mention, in my case, ordering of the relays and supervison of their installation.

My largest undertaking to date was the supervision of the installation and check-out of remote control and telemetering equipment at one of our largest substations.

I have also come in contact with such areas as system planning, street lighting, electric home heating, and use of mobile substations, but have not touched on these in much detail as yet.

Training Includes Meetings

My training includes attendance at a number of meetings including: (1) The monthly engineering department meeting where supervisory personnel get a chance to report their progress and discuss new problems; (2) Annual supervisory staff meetings at which top management discusses company policy; (3) The management training program being conducted by Penn State, which deals with supervision and handling of men.

I also serve on the relay committee of the Pennsylvania Electric Association. Here is an excellent opportunity to meet experienced engineers from utilities all over the northeastern United States and hear their problems, which to my surprise are not much different than our own.

For the young electrical engineer, I submit that the electric utility industry offers many challenges and many advantages (see box at left).

Advantages for Engineer

1. **Job Security**—I consider this to be the most important advantage and is certainly available in a utility due to the stability of the industry.
2. **New Fields**—A number of relatively new areas of interest are opening up, such as electronics, digital computers, microwave, and remote control devices.
3. **Challenges and Decisions**—These may include anything from where, how, what type and voltage class of transmission line should be added to the system to what is the best method of promoting electric heating.
4. **Fringe Benefits**—These include hospitalization plans, insurance plans, paid vacations, paid holidays, paid sick leaves, and payment toward further education.
5. **Advancement**—There is the opportunity for a young engineer to advance to some very responsible and well-paying positions in top management. This is due to a low hiring rate during the depression and World War II. Consequently there exists a 15-20 year gap in the electric utility personnel ladder.

Substation Design

A SPECIAL REPORT

KENNETH N. McLEAN
Northeastern Editor

Concern with high costs and community relations has replaced strictly engineering considerations as the major influence on future substation design. The continuing rise in costs for new plant, labor, and maintenance is making the substation designer take a hard look at any saving that could be made without sacrificing engineering advantages.

At the same time, the voice of John Q. Public is getting louder and having an effect, sometimes conflicting with the fight to reduce costs. His resistance to unsightly structures and noise, his sweeping migration of homes, shopping centers and factories to what were once cow pastures, and his continuing demand for more electric living are forcing the designer to work toward heavier load-designs, higher reliability, and higher voltage classes.

The effects of these forces—reexamination of materials and equipment, closer scrutiny of all operating practice, increasing push to standardize, and more concessions to the public are documented in the five following articles.

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Standardized Structures Trim Design Costs, Retain Flexibility 46

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Noise Level for Urban Subs Can Be Predicted 52

High Costs and Public Relations

Survey of 93 utilities shows increasing cost consciousness for materials and circuit designs, but growing expenditures for beautification. Tighter operating practices influence meter and capacitor installations

KENNETH N. McLEAN, Northwestern Editor

No revolution, but a wide and deepening evolution is taking place in utility substation design. The changes spring not from new technical concepts, but from two problems at least as familiar to topside management as to engineering staffs: money and people. The need to trim demands for the first and meet the demands of the second is being felt by substation designers everywhere. Neither is capable of a simple or clear-cut solution.

Here's what tomorrow's distribution and bulk substations will look like:

- More liberal use will be made of special structures, landscaping, and sound-attenuating walls to make new distribution substations more acceptable to residential neighbors.
- New materials and new equipment designed to reduce installation and maintenance costs will be making a bigger appearance.
- Capacitors will be moved out of distribution substations and onto individual feeders to work available cable capacity as hard as possible.
- Breaker-and-a-half bus circuits will become increasingly common in an effort to reduce costs and maintain growth flexibility.
- Rigid bus designs will replace strain bus to cope with increasing load and fault currents.
- Substation metering will get a strong going-over as system planners strive to get more reliable load and loss data to work with.

These conclusions are based on tabulations of a nation-wide survey by *Electrical World* editors. To get an accurate picture of today's trends and tomorrow's designs, *Electrical World* contacted 101 utility companies in all parts of the country. Included were companies serving urban areas and those serving rural areas, large utilities and small utilities, private companies and public power bodies.

Pressure for Beautification Increases

Of the 101 utilities approached, 93 or 92% completed and returned questionnaires, a valid indication of the concern about substation design. Substation designers were asked about past and future use of structural and bus materials, circuit designs, methods of protection, transformer loading, voltage regulation, metering techniques, and efforts to reduce public objections to substations.

That non-technical factors will have a major influence on future design is clearly shown by the increasing expenditures to mollify public objections to neighborhood distribution substations, (Table 1). Although utility men have long suffered under the general public's insistence that subs be beautiful as well as functional, hardening public feeling as more and bigger subs move into residential areas will force most companies to go well beyond previous practice.

Increasing the pressure are urban redevelopment programs, which utilities must go along with, and the general use of architectural treatment for new industrial construction and other types of utilities.

Table 1 compares the number of companies using each of the ten most common remedies with the number using each three or four years ago. The last two columns provide a rough index of increased or decreased use among companies already using a given method. Thus while four new companies plan to use house-type structures, three of the 14 already employing them have stepped up their use, while one com-

Table 1—How Utilities Cut Public Objections to Substations

	Number of Companies Using			
	On New Subs	3–4 Years Ago	In-creased Use	De-creased Use
House-type structures	18	14	7	1
Heavy landscaping	35	24	13	—
Moderate landscaping	75	72	17	8
Careful site selection	75	69	8	—
Low structure design	48	29	23	—
Sound attenuating walls	33	26	5	3
Special transformers	19	9	11	—
Metal-clad equipment	59	55	11	3
Rigorous site maintenance	66	61	11	—
Public information programs	17	14	6	—

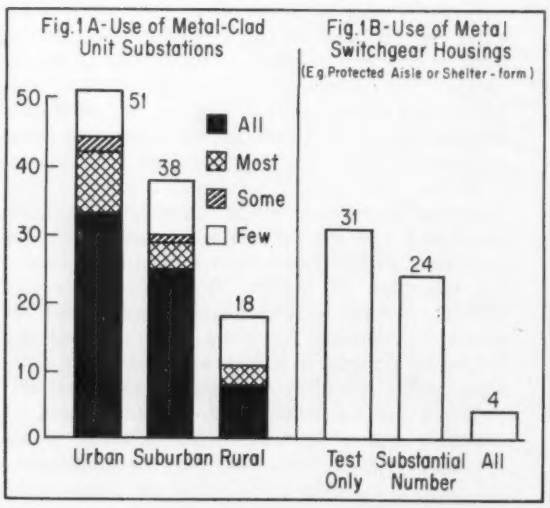


FIG 1—METAL-CLAD unit subs are used by most utilities. Over 60% will use some metal housings for switchgear

Shape Substation Evolution

pany will reduce use of this type of structure.

A few comparisons illustrate the size of the problem. The number of companies planning to use low structure design will increase 71% and the number using heavy landscaping, 42%. Cutbacks, indicated in the last column, were small or negligible.

Moreover, of the eight companies reporting decreases in use of moderate landscaping, four have shifted to heavy landscaping.

One geographic breakdown stood out in the results. Southern utilities in general rely much less on public information programs than those in other sections.

Most Check Both Steel and Aluminum

Another evidence of concern about public reaction was the heavy use of metal-clad unit substations planned, even in rural installations (Fig 1). In all, 55% companies will use metal-clads in some part of their system, 28% will use them for all urban stations and 8.5% for all rural. Although use varied somewhat by type of areas served, the only significant regional variation was a slightly lower use in the South. Of the seven companies planning a definite change in practice, six will use more metal-clads.

Efforts to reduce maintenance costs and speed repairs in foul weather are indicated by the large interest in metal housings for switchgear, such as Shelter-Form or Protected Aisle equipment. Over 60% of the respondents plan to use such equipment and three others, not shown in the table, were considering its use. Among the companies not planning such installations, the principal roadblock appeared to be possible labor troubles.

The immense concern with costs and the effort to balance increased first cost against later maintenance costs is illustrated by utilities' plans for structural material. Although the survey revealed that steel was well ahead, with only 5% of the companies using aluminum for all subs, more than half the companies were evaluating both materials (Table 2).

The apparent discrepancy between evaluation and application was clearly defined by comments that continuous first cost checks were being made and that aluminum cost was erratic. Many companies frankly

Table 2—Steel Structures Lead But Aluminum Interest Grows

	Bulk	Distribution
Use steel for all new subs	72	63
Use steel for most new subs	9	11
Use steel for some new subs	3	2
Use aluminum for all new subs	4	3
Evaluating both materials	49	51
Lean toward steel	40	38
Lean toward aluminum	9	13

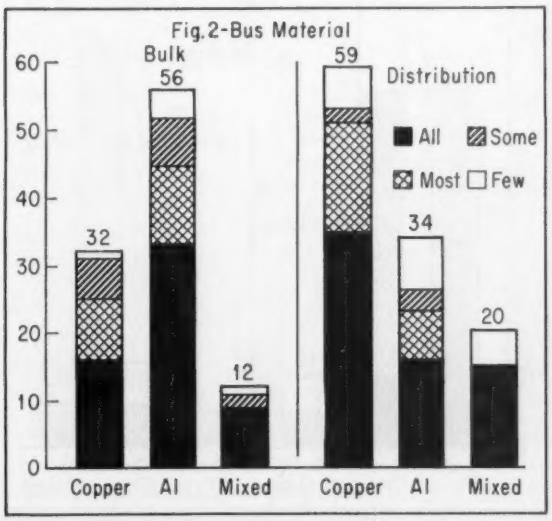


FIG 2—**ALUMINUM BUS** will predominate in bulk sub design, but copper holds lead in new distribution stations

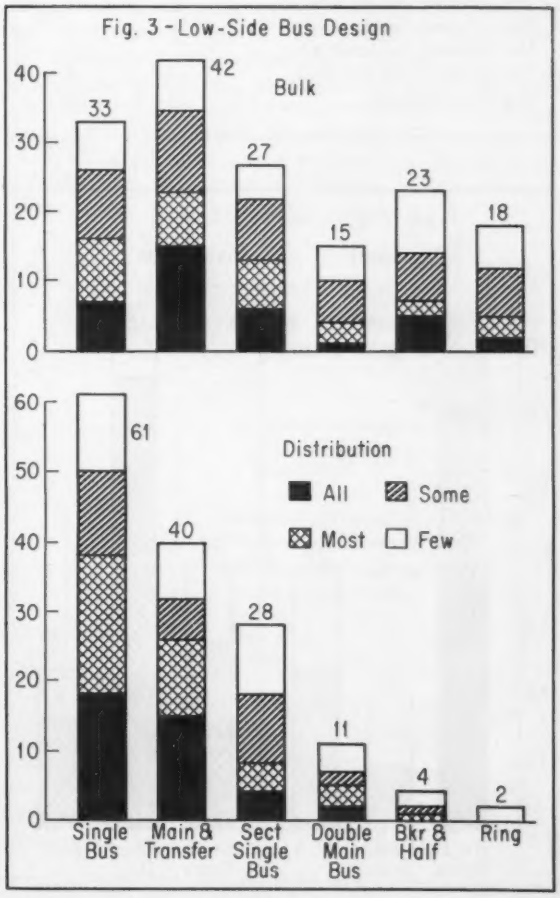


FIG 3—**BUS DESIGN PREFERENCES** show main-and-transfer scheme is still the favorite for bulk subs (upper graph)

admitted they were hedging their bets to cover future price variations in the two materials. Some were making new designs in both materials (page 46).

Not surprisingly, the preponderance of companies evaluating both but leaning toward aluminum were in the northeast, where heavy industry makes corrosion a problem. On the other side of the fence, three companies plan to use more steel at the expense of wood (page 45) and two companies will still use mostly wood.

In the bus field, aluminum promises to make a much better showing. As indicated in Fig 2, 33 companies will use aluminum for all bulk bus and 23 more for some buses, compared to 16 using copper on all and 32 using copper on some. Mixtures of the two materials were being used by 12 companies.

Table 3—Recloser Use Grows for Low-Side Protection

	Distribution	Bulk
Use breakers for all new subs	26	75
Use breakers for most new subs	23	11
Use breakers for some new subs	21	1
Use breakers for few new subs	7	—
Use reclosers for all subs	7	1
Use reclosers for most subs	14	—
Use reclosers for some subs	21	1
Use reclosers for few subs	19	3
Use other methods	5	2

Of the 34 companies planning definite changes in bulk substation bus material, 32 specified increased use of aluminum. On the distribution side, 26 of the 28 making changes will use more aluminum. However, one utility that made an earlier change from copper to aluminum plans to go back to copper.

Rigid Bus More Common Than Strain

Accompanying the change in material was a definite trend from strain buses to rigid buses. The reasons cited for both changes were similar: higher load currents and higher voltages. Companies planning to use mostly rigid bus outnumbered those using mostly strain by 2.5:1 in distribution stations and 4:3 on bulk stations. Of the 11 companies reporting changes in distribution stations, eight will use more rigid bus, as will eight of the nine planning specific changes in bulk construction.

Single buses will remain predominant in distribution stations and main and transfer combination in bulk subs, Fig 3. But economics and flexibility for future growth were making many designers scrutinize the breaker-and-a-half design. Eight of the nine utilities planning new types of bus circuits, not shown in Fig 3, were moving to breaker-and-a-half, and of the eight, three were considering its use in distribution subs. Behind part of the interest was increasing use of direct conversion from transmission voltages to a higher distribution voltage, and the ease of converting the breaker-and-a-half to ring bus as loads and circuits grow.

A major trend in protection methods is the healthy increase in the use of reclosers for distribution subs. The total number of companies planning some use of

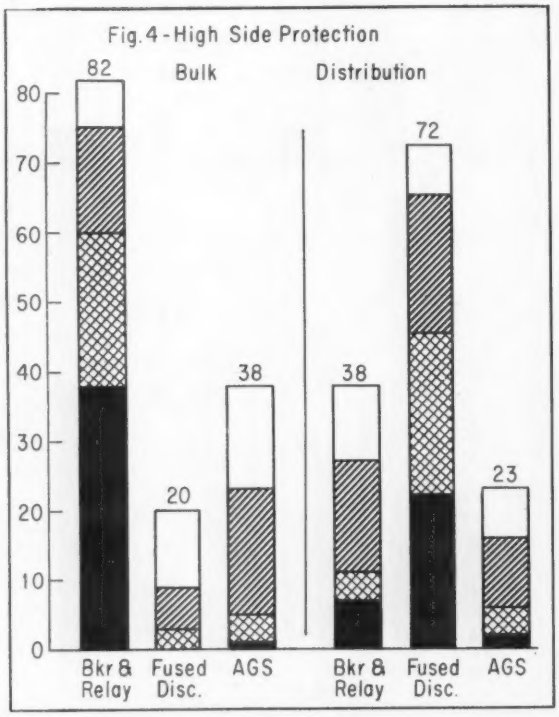


FIG 4—**FUSED DISCONNECT SWITCHES** remain first choice for high side protection in new distribution stations

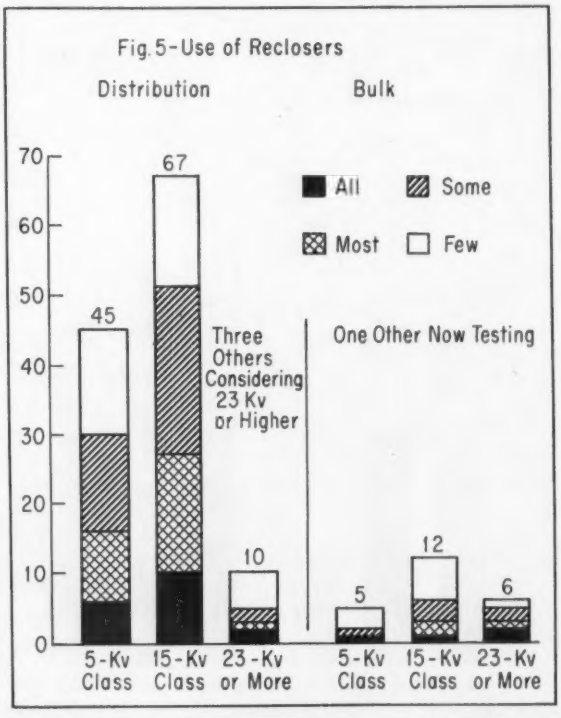


FIG 5—**SOME 15-KV RECLOSERS** will be used by 70% of utilities for distribution subs. Use in bulk subs is growing

reclosers for low side protection—61—was not far behind the total number using breakers—70—although the number using only breakers was four times as great as the number using reclosers exclusively. Among the companies making limited use of reclosers, the principal deterrent reported was limitations in duty ratings.

Breakers and relays will remain an easy first choice for high-side bulk substation protection, especially as bulk subs get bigger and more critical. Only two changes were reported, both new users of grounding switches. In addition, six companies plan to use transfer trip schemes and three, air break switches.

Fused disconnect switches will be the mainstay for high-side distribution sub protection, Fig 4, with some increase in breakers or automatic grounding switches as loads increase. Among the methods not shown in Fig 4 are two companies using vacuum switches, two with transfer trip schemes, and two, automatic grounding switches.

Wide Use of Reclosers Indicated

The wide interest in reclosers is confirmed by the results shown in Fig 5. More than two-thirds of the companies reporting will use some 15-kv class reclosers for distribution subs and half, some 5-kv class. Comments indicated that applications would be largely remote or rural stations and use will be higher in the Midwest and West than in the East. That wider use would follow an increase in ratings and voltage classes available is evidenced by the number of companies already planning to use equipment of 23 kv or higher and by notations from three other utilities that they were considering such applications.

The load tap changer seems established as tomorrow's main method of substation regulation. In both bulk and distribution subs, the number of companies planning to use LTC's exclusively easily outnumbered the exclusive users of all other methods. Moreover, seven of the 21 companies reporting changed methods in distribution subs will increase use of LTC, against five increasing use of switched capacitors and three of bus regulators. Principal reason given was the smaller space requirements and fewer components. Only one company reporting intends to use less LTC equipment in new substations.

Switched capacitors were in second place for regulation in bulk subs, and four companies indicated plans to use more of them. Only one utility reported a shift to bus regulation, and ten will decrease or eliminate regulation in bulk substations being planned.

Capacitors Move Out of Lines

As indicated in Table 4, less than half the utilities surveyed will have major capacitor installations in new substations. In part, this reflects a tendency to move capacitors out on the lines where corrective action is maximized.

As might be expected, methods of controlling capacitor installations differ in bulk and distribution subs. In bulk subs, almost 60% of the respondents will use manual control or remote control by an operator, while voltmeter control predominates in distribution stations. Among the other methods not shown in Table 4 are three companies using voltage-current combinations, two using var control, and six others using temperature in combination with time, current, or vars.

Methods of switching capacitors will differ, too, with oil circuit breakers most common in bulk subs, where currents are higher, and oil switches in a majority of distribution stations. Other methods mentioned occasionally were air magnetic switches, and fused load interrupters.

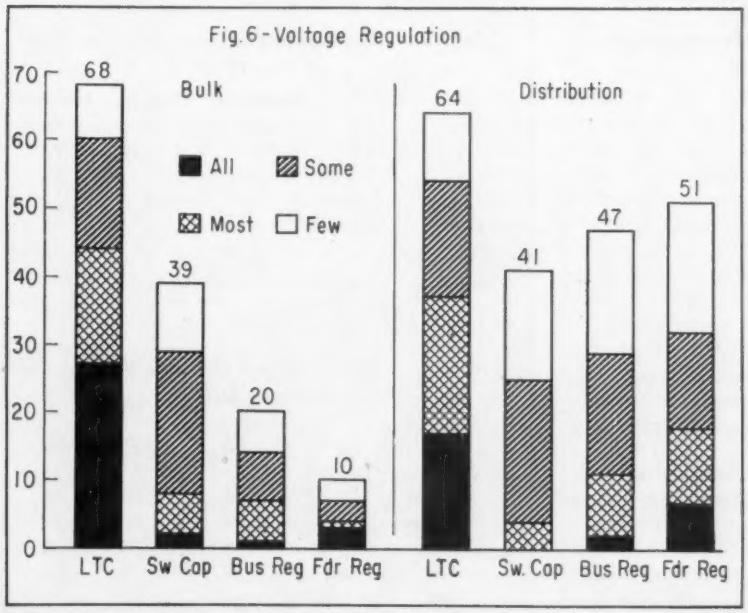


Table 4—Capacitors Are Moving Out of Subs

	Distribution	Bulk
Number of companies planning major installations	32	39
Voltmeters Are Widely Used Method of Control . . .		
Manually by operator (Including remote)	7	23
Voltmeter	12	8
Time clock	8	3
Voltage — time	5	6
. . . and Oil Switches Major Switching Method		
Air blast breakers	5	3
Oil circuit breakers	8	15
Oil switches	22	5
Vacuum switches	4	7
Other	5	3

FIG 6—LOAD TAP CHANGERS run well ahead of all other methods of voltage regulation in both bulk and distribution substations. Although switched capacitor use will grow slightly, less than half will have major capacitor installations

Perhaps the greatest variation in design will be in methods of loading, provision for spare capacity, and provisions for emergency operation. Although the type and size of the service area had an obvious effect, differences in voltages used and operating concepts also played an important part.

Thus most of the companies reporting zero spare capacity in transformers were those serving relatively compact areas. In general these companies relied at least moderately on mobile transformers and substations for back-up. But a few Western companies and a number of Southern companies will have little or no spare capacity in new construction.

Of the utilities surveyed, 21 specified that loading was based on ASA ratings, while 26 based spare capacity estimates on nameplate ratings, usually a forced cooling rating. Several companies factor the number of units or other capacity in the area into their loading calculations.

28% Ignore 65C Transformer Ratings

Typical of the variation in loading philosophy was the reaction to the new 55C/65C transformer ratings (Table 6). Almost 25% of the companies responding have yet to decide what, if any, use they will make of them. About 28% will not use them at all, and one-third will use them for both normal and emergency conditions. A few others plan to use the new margin to allow slightly higher peaks or as an increased safety factor. Some companies frankly admitted they were standing pat until the dust settled.

Similar variation in practice shows up in methods of maintaining primary feeder service when the feeder switchgear is down for maintenance. Nineteen will use tie switches in most subs, and 26, bypass switches. About 13% will rely on feeder ties outside the station, and four on transfer buses, either alone or in combination with fused disconnect switches. Two companies will use sectionalizing; one, loop feed; and four, bypass breakers, fuses, or fused disconnect switches.

Substation metering appeared to be in a state of flux in a large number of utilities. As concern about the cost of losses increases and planners play a bigger role in design, many utility men want more metering to get an accurate picture of line conditions. On the other hand, many operating people are concerned about the high cost of manpower required to take, collect, and use the data.

Service Area Influences Metering Practice

As indicated in Tables 7 and 8, a great majority of companies plan to meter feeder current on both distribution and bulk subs, mainly with permanent meters. Those not metering feeder current are principally rural companies who rely on kwhr meters on the transformer or, to a lesser extent, ammeters on the transformer.

By contrast, most companies will meter voltage principally on the transformer, with only 30% metering feeder voltage in bulk subs and 20% in distribution subs. Most of the companies measuring feeder voltage are those with urban or small service areas, although the practice is somewhat higher among southern utilities than those in other parts of the country.

Perhaps the practice on which the greatest number of utilities agree is the source of manpower to design their new substations. Of the respondents, 72 companies will do all their own distribution sub design and seven more will do most of it. Similarly, for bulk subs, 61 will do all their own work and another nine a majority of it. Of the four changes in practice reported, two will increase reliance on the utilities' own staffs and two will increase their use of an outside designer.

Table 5—More Mobiles for Emergencies in One-bank Subs

Outside circuit switching in all cases	23
Outside circuit switching in most cases	13
Outside circuit switching in some cases	28
Outside circuit switching in few cases	8
Mobile unit in all cases	8
Mobile unit in most cases	9
Mobile unit in some cases	26
Mobile unit in few cases	11
Other methods	4

Table 6—Few Companies Are Using 65C Transformer Ratings

Will not use	25
Very little use	8
Undecided or still studying	22
Apply for emergency only	5
Apply for normal & emergency loading	29

Table 7 — Permanent Meters Will Do Most of The Work

	Switched	Permanent	Plug-in	Portable
KWHr	4	62	7	8
I	34	71	14	14
V	33	64	8	13
KVAR	17	58	14	18
P.f.	1	9	—	11
*KW	6	8	6	5

*Not asked in survey; information volunteered.

Table 8 — Here's What Utilities Will Meter in New Subs

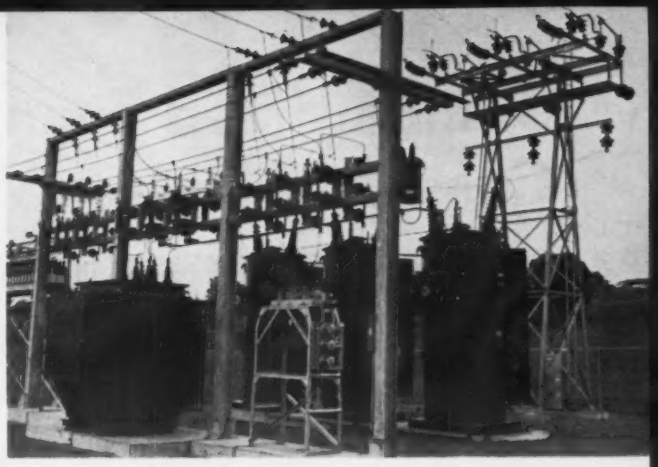
	Distribution		Bulk	
	Tsf	Fdr	Tsf	Fdr
KWHr	55	16	56	15
Current	57	77	62	78
Voltage	60	19	76	27
KVAR	31	14	70	33
P.f.	6	2	9	3
*KW	7	—	11	12

*Not asked in survey; information volunteered.

Steel Cuts Costs In Lumber Country

Lower annual charges, comparable erection costs make steel preferable to fir poles

W. E. HERCHER, Electrical Engineer, California Oregon Power Co, Medford, Ore.



Although the California Oregon Power Co is located in the heart of the Oregon lumber industry, a definite trend from wood to steel substation structures seems in prospect for the COPCO system. Behind the change are: increasing maintenance costs for wood stations; a solid member steel design which provides suitable strength-to-weight ratios at reasonable costs; and a comparative cost analysis that showed annual charges for steel were lower.

For a typical 3-circuit steel substation, labor and material costs—excluding transformers, regulators and breakers—were $20,020. Comparable costs of a station of wood were $17,650. However, the $2,370 saving in first costs of a wood substation was more than compensated for by a saving of $418 in annual charges if the steel sub were used. Assuming a 20-year life for wood and 50 for steel, the break-down was:

Annual Charges	*Wood*	*Steel*
Depreciation	5%	2%
Interest	6%	6%
Taxes and Insurance	4%	4%
Maintenance	1%	0
Total	16%	12%

Thus annual charges for the wood station are $17,650 x 16% or $2,820; for the steel, $20,020 x 12%, or $2,402, a difference of $418 in favor of steel.

In addition, the steel design has other advantages:

- A neater appearance, improving customer relations
- Greater ease of operation
- 100% salvage of structures if the sub is moved.

Since May, 1959, when the first new steel sub was built, a fairly close record of labor charges has been kept for the seven steel stations now on the system. These subs have a combined capacity of 46-Mva nameplate and total of 20 distribution feeders. Surprisingly, erection labor for a steel structure is about 98% of that for an equivalent circuit wood station, where much labor is used in on-the-job cutting, drilling, and fitting of poles, timbers, and catwalks. By contrast, steel is completely prefabricated and, for a typical two- or three-circuit sub, can be assembled in eight to 12 hr by crews inexperienced with steel.

Prior to 1958, only one of the 136 distribution subs on the COPCO system was built entirely of structural steel. Although some steel crossarms and beams had been used, wood poles had always provided the basic support for the structure. Before World War II, the main supports were generally butt-treated cedar poles, with an anticipated life of 20 years or more.

During the post-war boom, many stations were built with butt-treated fir poles because of the scarcity of good cedar poles. By now, most of these post-war subs have required extensive maintenance and even complete rebuilding. This is expensive and complicated when the sub is not backed-up by another sub and outage time must be minimized. In 1958, COPCO realized that maintenance on wood structures was becoming excessive and began re-evaluating a steel design.

Many types of prefabricated structures from equipment manufacturers were considered, but the first cost of these structures was excessive compared to an all-wood design. Although the lattice columns and beams used in most of these prefabricated designs have a high strength-to-weight ratio, it was felt that fabrication and erection of these lattice members was a large factor in the additional cost of such a design. It seemed reasonable to use a solid member, with some additional material, to get equivalent strength, if fabrication and erection costs could be cut.

15% Weight Increase Cuts First Cost 20%

The design finally chosen as most nearly meeting COPCO requirements is shown above. The main supports for the low voltage structure are 8-in. x 10-in. x 20-ft wide-flange columns, installed on 12-ft centers. Connecting members for mounting disconnect switches are 4x4x14-in. angles. The top members, from which the distribution circuits pull away, are 4x4x$\frac{7}{16}$-in. All structural members are hot-dip galvanized. Although total weight of the structure was increased about 15%, a saving of about 20% in first cost was achieved.

Footing for this structure consists of 8-ft deep holes, drilled with a 24-in. power auger. Anchor bolts for the main columns, which extend to the bottom of the footings, are 4-ft, 1½-in. x 8-ft per column. These long anchor bolts are the main reinforcement for the footings; only a few horizontal reinforcing ties are needed. Continuous concrete pads under the low voltage structure and the main footings are poured simultaneously. Experience has shown that the continuous pad under the low voltage structure costs no more than individual pads under each piece of equipment, because of savings in the labor required to form up each pad.

The 66-kv structure is basically one used previously as a dead-end structure for strain buses in transmission subs. This 30-ft structure has been modified to provide mounting for the 66-kv tilting insulator disconnect switches and an access platform for the 66-kv boric acid power fuses.

Standardized Structures Trim Design Costs but Retain Versatility

15 and 34.5-kv designs provide flexibility for voltage class, type of regulation, and number of circuits

J. J. MILLER, Assistant to Chief Engineer, Western Division, Niagara Mohawk Power Corp, Buffalo, N. Y.

Four standardized structures for distribution stations are the first fruits of a broad-gauge station standardization program at Niagara Mohawk Power Corp. Aimed at reducing design costs and unifying design and operating procedures throughout the system, the program may ultimately provide standard designs for all system transmission and distribution stations.

To make the standardized designs as versatile as possible, separate high and low-side structures are used and designs are made both for steel and for aluminum. The four structures completed to date include:

- A rectangular, metal, low-side structure, designed for 15-kv and used for all voltages down to 4 kv. Modular in design, it can accommodate future circuits by simply adding more unit bays;
- A square metal high side structure, designed for 34.5-kv, and used for either 34.5 or 23-kv incoming lines;
- A 34.5-kv metal portal;
- A 34.5-kv wood pole structure.

The structures above will be for any distribution station—rural, urban, or suburban—where an open structure is acceptable. Of the three 34.5-kv structures, the rectangular one will be used for the majority of urban and suburban installations, and for supplying industrial loads. The portal is used where there is only one incoming line or for stations serving a single customer. The wood pole structure is principally for rural installations and some industrials.

Plans for the future include a standardized 34.5-kv metal structure for the low side of bulk stations and, possibly, 115-kv portal and rectangular structures.

The standardization program has these distinct advantages:

- Design time is cut sharply;
- Purchasing is simplified;
- All company divisions now have a uniform approach to station design and can develop common operating procedures;
- Use of separate structures permits men to work on one without de-energizing the other;
- Operating and maintenance safety is improved by increased spacing and judicious location of switchgear and fuses;
- Use of separate structures allows the station to accommodate any number of transformers of any rating, either single or three phase;
- The unit bay design of the low side structure provides great flexibility for future expansion;
- The low and high side rectangular structures can be used with a wide variety of circuit designs (Fig 1 and Fig 2) including variations in the number of incoming lines, number of banks, and number of bays;
- Similarly, the low side structure can easily accommodate any type of equipment for voltage regulation.

Division Practices Varied

Like many other utilities, Niagara Mohawk has grown from amalgamation of numerous smaller companies. As labor and material costs continued to increase, variances in existing practices from one division to another became less and less desirable.

For example, the division serving western New York State had used a single high-over-low structure, 21 ft square across the surface, for distribution substations. This structure was very economical. Moreover, because considerable spacing was needed for the high voltage portion of the structure anyway, transfer facilities could be included on the low voltage portion by merely adding tubing, insulators, and switches at a very small cost. Where reclosers and small circuit breakers were widely used, it was a highly satisfactory structure. However, as station size and capacity grew, requiring larger and heavier switchgear, structures became very crowded.

By contrast, the eastern division, serving the Albany area, had been using separate structures for 10 or 15 years. Although somewhat similar to the new design, their low side structure had smaller bays—6x12 ft—and was usable only up to 5 kv. Moreover, because of a different operating approach, they had no provision for transfer facilities inside the station but relied on external feeder ties to pick up the main portion of the feeders and bypass the faulted substation circuits. The central division, serving the area around Syracuse and central New York State, used both approaches, with a number of variants.

A committee representing engineering men of each of the three division was formed to review current practice in each and develop a uniform approach. Its first decision was that separate high and low side structures would be used. Once this concept was established, work began on the low voltage structure.

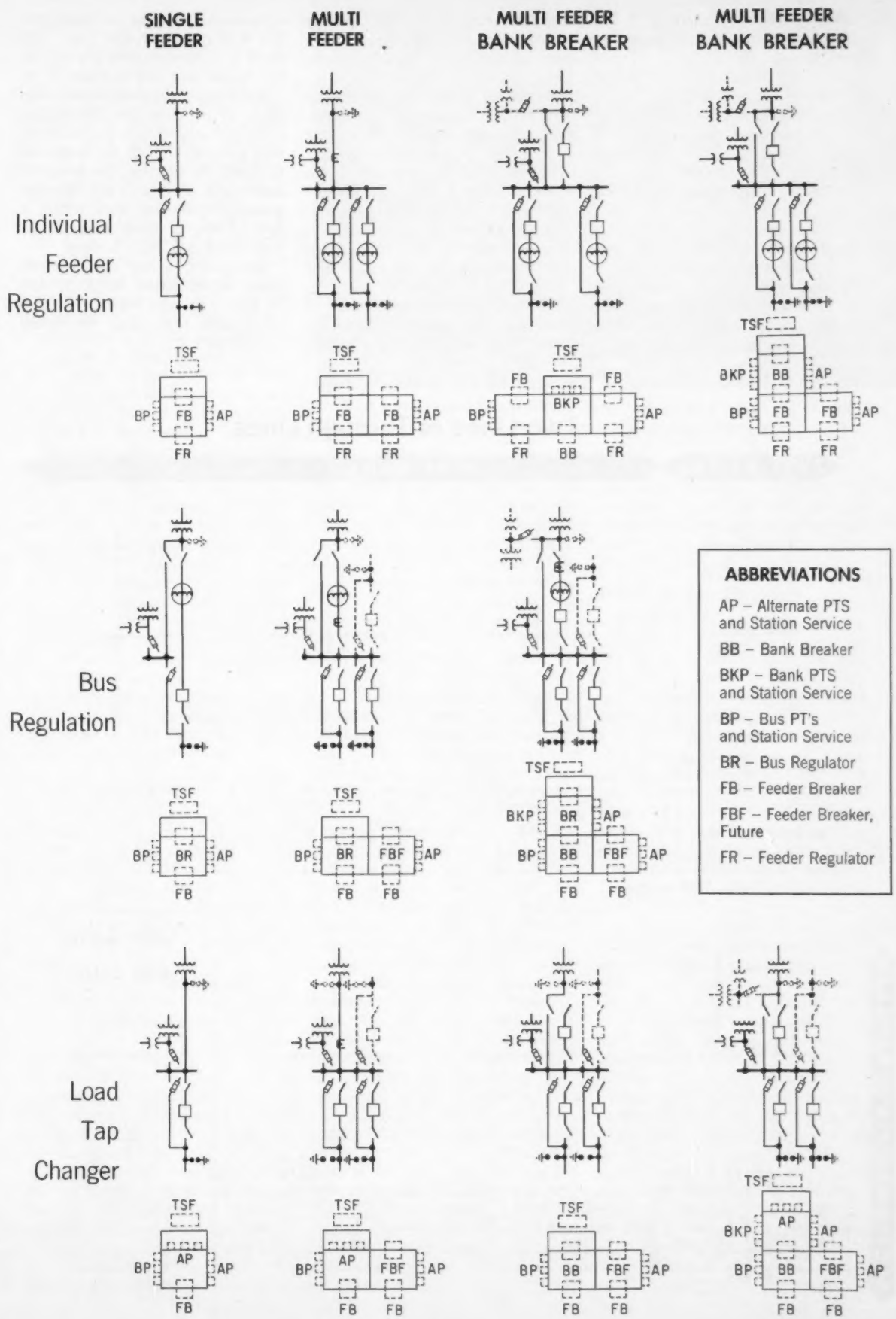
The basic low voltage structure is a 10x12-ft bay, approximately 20 ft high, designed for all voltages up through 15 kv. Additional feeders can be accommodated by adding similar bays to the original one.

The design of the unit bay was arrived at by first determining the most commonly used low voltage arrangements throughout the system (Fig 1) and then developing a structure which would fit these needs, provide flexibility for new arrangements, and space for higher distribution voltages in the future.

To maximize flexibility, each bay is designed to accommodate any of the following alternatives:

- Feeder regulator and feeder breaker;

FIG 1—ELEVEN BASIC CIRCUITS can be handled by low side, 15 kv structure, with bus regulation, feeder regulation, or load-top-changing


SINGLE FEEDER
MULTI FEEDER
MULTI FEEDER BANK BREAKER
MULTI FEEDER BANK BREAKER
Individual Feeder Regulation
Bus Regulation
Load Tap Changer
TSF
BP
FB
AP
FR
BR
FBF
BKP
BB
ABBREVIATIONS
AP – Alternate PTS and Station Service
BB – Bank Breaker
BKP – Bank PTS and Station Service
BP – Bus PT's and Station Service
BR – Bus Regulator
FB – Feeder Breaker
FBF – Feeder Breaker, Future
FR – Feeder Regulator

• Two feeder breakers;
• Bus regulator and feeder or bank breaker;
• Bank breaker and feeder breaker.

Combinations of these arrangements are used for single bank, single feeder, or multiple feeder stations, with bus regulation, feeder regulation, or load-tap-changing transformers. A 12-ft bus tie bay provides for multiple unit stations with similar feeder and regulation possibilities.

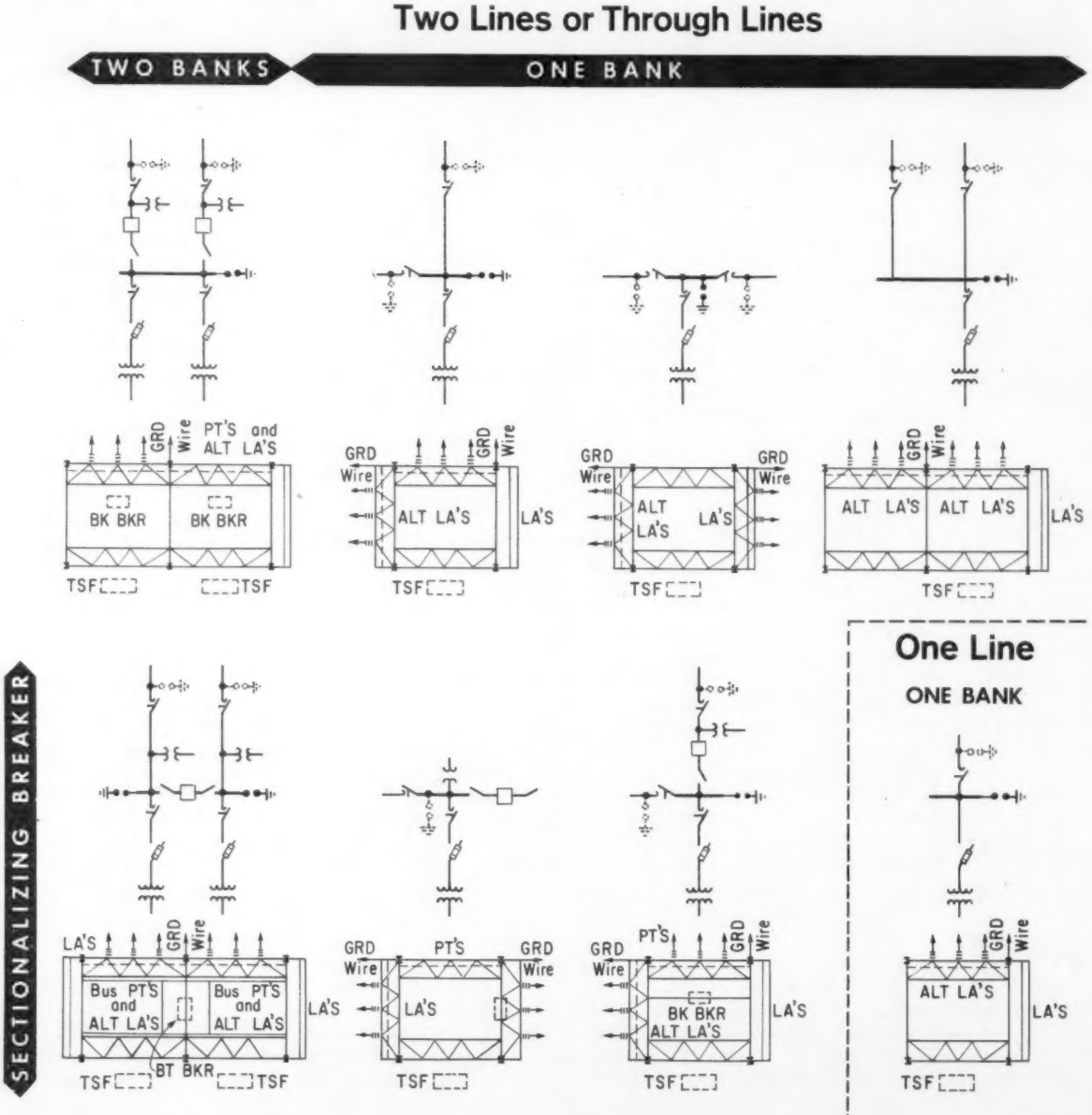
In setting up the basic design for the low side structure, Niagara Mohawk engineers found that the cost of 15-kv design was only a few hundred dollars more than for 5 kv. Thus, although a great deal of 5-kv class distribution is used in the system, the greater flexibility and provision for possible higher distribution voltage in the future made the 15-kv structure desirable.

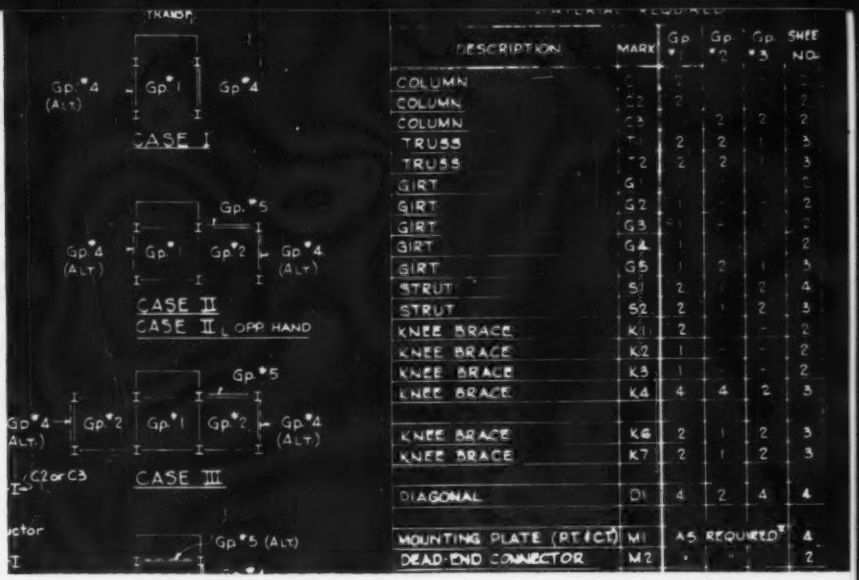
Cost comparisons were made of bays with one and two feeders per face. When only one or two feeders were needed, the cost per feeder was less with the two-feeder face. But when three feeders were needed, the two-feeder face was impractical.

Similarly, some consideration was given to reducing the bay dimensions, but this made it impossible to take feeders off both the front and the back. In addition, the structural dimensions needed to get adequate working clearances were within a foot or two of those required for both front and back feeders.

Ultimately, a bay design which could accommodate single feeders on both front and back or on both sides proved to have the lowest overall costs.

FIG 2—RECTANGULAR 34.5-KV high-side structure is adaptable to one or two incoming lines, sectionalizing or line breakers, one or two bays, and single or double bays. Designs will be made in both steel and aluminum





DESCRIPTION	MARK	Gp. *1	Gp. *2	Gp. *3	SHEET NO.
COLUMN	C1	1	-	-	-
COLUMN	C2	2	-	-	2
COLUMN	C3	-	2	2	2
TRUSS	T1	2	2	1	3
TRUSS	T2	2	2	1	3
GIRT	G	1	-	-	2
GIRT	G2	1	-	-	2
GIRT	G3	1	-	-	2
GIRT	G4	1	-	-	2
GIRT	G5	1	2	1	3
STRUT	S1	2	1	2	4
STRUT	S2	2	1	2	3
KNEE BRACE	K1	2	-	-	2
KNEE BRACE	K2	1	-	-	2
KNEE BRACE	K3	1	-	-	2
KNEE BRACE	K4	4	4	2	3
KNEE BRACE	K6	2	1	2	3
KNEE BRACE	K7	2	1	2	3
DIAGONAL	D1	4	2	4	4
MOUNTING PLATE (PT. ACT.)	M1	AS REQUIRED*			4
DEAD-END CONNECTOR	M2	*	*	*	2

FIG 3—ENGINEERING DRAWINGS indicate number of standardized members (right) needed for each of the possible circuit arrangements shown at left

The low side structure can accommodate underground, open wire, or aerial cable take-off. The design height permits service to come into the station from a pole across the road. Overall height is slightly greater than that of the old high-over-low structure used in the western division, but about the same as the eastern division structure.

The new design has many significant safety features. For example, all stick operated disconnects have approximately a 30-deg clear pull angle. Similarly, all fuses are on the outside of the structure to permit replacement and accessibility with minimum hazard. Fused by-pass facilities on the face of the structure provide a protected line while the by-passed switch or breaker is being repaired or inspected.

The committee established standard electrical clearances for station work throughout the system. These clearances are provided in handy reference form on the basis of preferred nominal system voltage, BIL and kv class. All standard structures are designed to provide at least the recommended standard clearances. For example, the low side structure has a minimum 14.4-kv (kv class) vertical clearance to unguarded live parts of 9 ft-2 in. even though it is recognized that the 7.2-kv (kv class) for which it would presently be used calls for a minimum clearance of 8 ft-6 in.

Design for 0.5-In. Ice

The 15-kv unit bay is designed for conductor loads of 1,500-lb per conductor, or 2,000 to 4,000 lb per aerial cable, with maximum take-off angle 20 deg from normal. Tensions are considered to be caused by the conductor weight, ½-in. of radial ice, and 8 lb per sq ft of transverse wind.

Ice loading on the structure was considered to be equal to the weight of the steel structure, or 2.8 times the weight of the same structure designed in aluminum. This is approximately equal to ½-in. of radial ice on the structure. Ice loading on the equipment was assumed to equal 50% of the equipment weight, but not to exceed one in. of radial ice. Wind loads were evaluated as 25 lb per sq ft on the projected area on the windward side of the structure, plus 12.5 lb per sq ft on the leeward.

To simplify foundation construction, anchor bolt spacing for both the low voltage unit bay and the high side square structure is identical. For each structure, standard structural shop detail and erection drawings, electrical assembly drawings, and foundation drawings will be made available to designers throughout the system.

In applying the new concept, the design engineer selects from a series of basic one-line diagrams (Figs 1, 2) the one most nearly suitable for the given station. The one-line lists all pertinent drawings and tells the engineer how many of each standardized member are needed (Fig 3). The local engineer has only to specify location of arresters, station service, and type of equipment. Bolt holes for all possible uses are provided in the basic design. The entire low side structure may be purchased as a unit, including insulators, bus work and arresters.

Use of the standardized drawings is expected to reduce design and drafting time sharply. Structural variations will be rare and will be provided for as they occur. Thus, although the low side structure is intended to accommodate aerial cable, open-wire, or underground take-off, no detailed drawings for underground take-off have been made yet. When the first such application is needed, the local design engineer will make the drawings and send them to the committee. After approval, they will then become part of the standard design. Electrical assembly drawings, simplified by standard structures, will require minor variations for individual conditions, but man-hours for these should be comparatively low.

Design Emphasizes Safety

Structural shop detail drawings, prepared with economy of shop labor in mind, will be used for purchase of the standard stations, without necessitating design or detail layout by the supplier.

The 34.5-kv square structure can also serve a wide variety of circuit designs. As indicated in Fig 2, it can accommodate one or two incoming lines, one or two banks, single or double bays, and sectionalizing or line breakers. Both it and the 34.5-kv portal will be designed for either steel or aluminum members.

The same concern for safety of operating and maintenance men guided design of the 34.5-kv structures. Although the new structures are 25 ft high, slightly higher than older structures, they provide a 12-ft, 6-in. clearance underneath a minimum of 9-ft, 6-in. clearance to unguarded live parts. In contrast to earlier portal structures, the conductor is no longer run under the beam, but is brought back over the beam to the transformer. Fuses are now located on the side away from the transformer. As in the 15-kv structure, an attempt has been made to keep all switches accessible and easily operable.

Chart Provides Quick Estimate of

DAVID REPS, Distribution Engineer, Electric Utility Engineering Dept, Westinghouse Electric Corp, East Pittsburgh, Pa.

A rapid approximation of relative per-kva total costs of the most common substation designs, shown below, can be obtained by assigning relative cost values to the steel structure and high voltage switching, the transformer, and the low voltage metal-clad switchgear of each substation design.

Transformers are equipped with forced-air cooling and automatic load tap-changing. In double-ended substations, the forced-air-cooled rating of each transformer is equal to the self-cooled rating of a single transformer sutsbation required for the same load. All installation and accessory costs are included.

All costs are in per cent. The substation in Fig 1b, with a 34.5-4.16-kv rating and each primary feeder loaded to 1,250 kva, is used as a reference. The sum of the dollars-per-kva for each of its major components is taken as 100%.

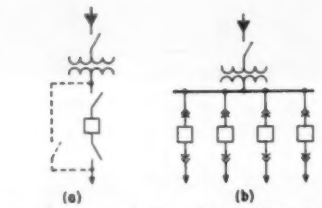


FIG. 1 SIMPLEST FORM OF DISTRIBUTION SUBSTATIONS

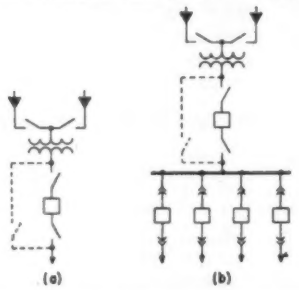


FIG. 2 ALTERNATE SUBTRANSMISSION SUPPLY

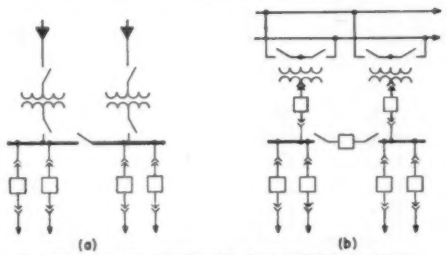


FIG. 3 DUPLICATE TRANSFORMERS AND SUBTRANSMISSION CIRCUITS

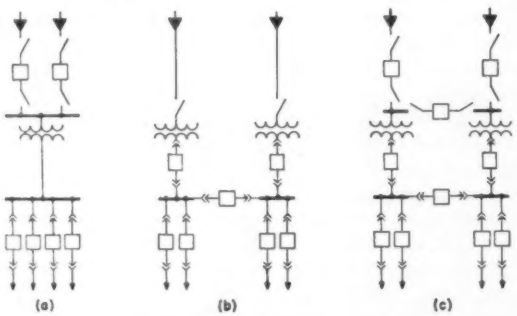


FIG. 4 AUTOMATIC THROWOVER SWITCHING FOR RAPID SERVICE RESTORATION

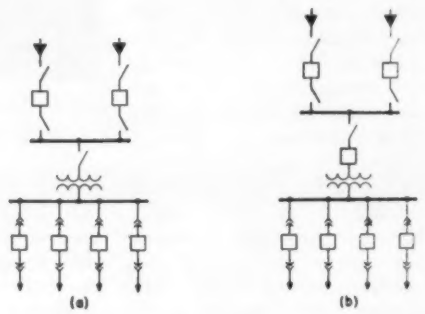


FIG. 5 DUPLICATE SUPPLY TO ELIMINATE SERVICE INTERRUPTIONS DUE TO SUBTRANSMISSION OUTAGES

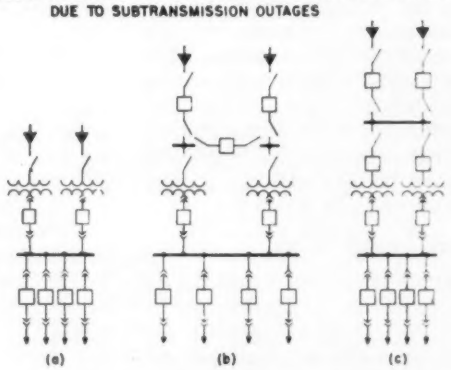


FIG. 6 SPOT-NETWORK TYPE DISTRIBUTION SUBSTATIONS

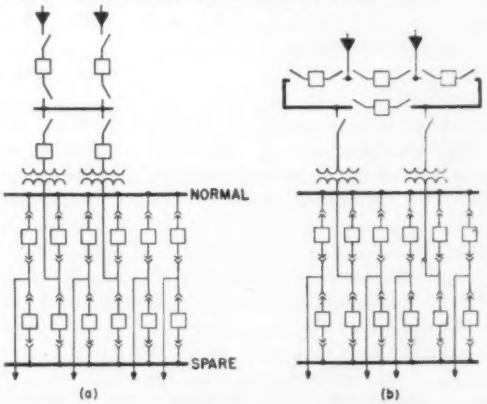


FIG. 7 DISTRIBUTION SUBSTATIONS WITH ELABORATED BUSSING ARRANGEMENTS

Distribution Substation Costs

*** Comparative Costs of Distribution Substations (All costs in per cent)**

	Subtransmission Voltage	138 KV						69 KV						34.5 KV					
	Primary-Feeder Voltage	13 KV	13 KV	13 KV	4 KV	4 KV	4 KV	13 KV	13 KV	13 KV	4 KV	4 KV	4 KV	13 KV	13 KV	13 KV	4 KV	4 KV	4 KV
	Primary-Feeder Loading-Kva	1250	5000	10000	1250	2500	5000	1250	5000	10000	1250	2500	5000	1250	5000	10000	1250	2500	5000
See Fig. 1a	High Voltage Switching	112	28	14	112	56	28	32	8	4	32	16	8	16	4	2	16	8	4
	Transformer	210	92	70	210	135	92	121	64	50	121	86	64	103	52	39	103	72	52
	Low Voltage Switching	64	16	8	44	22	11	64	16	8	44	22	11	64	16	8	44	22	11
		386	136	92	366	213	131	217	88	62	197	124	83	183	72	49	163	102	67
See Fig. 1b	High Voltage Switching	28	7	4	28	14	7	8	2	1	8	4	2	4	1	1	4	2	1
	Transformer	92	57	46	92	70	57	64	40	35	64	50	40	52	35	29	52	43	35
	Low Voltage Switching	64	16	8	44	22	11	64	16	8	44	22	11	64	16	8	44	22	11
		184	80	58	164	106	75	136	58	44	116	76	53	120	52	38	100	67	47
See Fig. 2a	High Voltage Switching	224	56		224	112		64	16		64	32		32	8		32	16	
	Transformer	210	92		210	135		121	64		121	86		103	52		103	72	
	Low Voltage Switching	64	16		44	22		64	16		44	22		64	16		44	22	
		498	164		478	269		249	96		229	140		199	76		179	110	
See Fig. 2b	High Voltage Switching	56	14		56	28		16	4		16	8		8	2		8	4	
	Transformer	92	57		92	70		64	40		64	50		52	35		57	43	
	Low Voltage Switching	80	20		55	28		80	20		55	28		80	20		55	28	
		228	91		203	126		160	64		135	86		140	57		115	75	
See Fig. 3a	High Voltage Switching	56	14		56	28		16	4		16	8		8	2		8	4	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	64	16		44	22		64	16		44	22		64	16		44	22	
		288	128		268	176		188	86		168	116		162	76		142	96	
See Fig. 3b	High Voltage Switching	64	16		64	32		20	5		20	10		10	3		10	5	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	112	28		78	39		112	28		78	39		112	28		78	39	
		344	142		310	197		240	99		206	135		212	89		178	114	
See Fig. 4a	High Voltage Switching	192	48		192	96		80	20		80	40		64	16		64	32	
	Transformer	92	57		92	70		64	40		64	50		52	35		52	43	
	Low Voltage Switching	64	16		44	22		64	16		44	22		64	16		44	22	
		348	121		328	188		208	76		188	112		180	67		160	97	
See Fig. 4b	High Voltage Switching	56	14		56	28		16	4		16	8		8	2		8	4	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	112	28		77	39		112	28		77	39		112	28		77	39	
		336	140		301	193		236	98		201	133		210	88		175	113	
See Fig. 4c	High Voltage Switching	260	65		260	130		112	28		112	56		92	23		92	46	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	112	28		77	39		112	28		77	39		112	28		77	39	
		540	191		505	295		332	122		297	181		294	109		259	155	
See Fig. 5a	High Voltage Switching	192	48		192	96		80	20		80	40		64	16		64	32	
	Transformer	92	57		92	70		64	40		64	50		52	35		52	43	
	Low Voltage Switching	64	16		44	22		64	16		44	22		64	16		44	22	
		348	121		328	188		208	76		188	112		180	67		160	97	
See Fig. 5b	High Voltage Switching	260	65		260	130		112	28		112	56		92	23		92	46	
	Transformer	92	57		92	70		64	40		64	50		52	35		52	43	
	Low Voltage Switching	64	16		44	22		64	16		44	22		64	16		44	22	
		416	138		396	222		240	84		220	128		208	74		188	111	
See Fig. 6a	High Voltage Switching	56	14		56	28		16	4		16	8		8	2		8	4	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	96	24		66	33		96	24		66	33		96	24		66	33	
		320	136		290	187		220	94		190	127		194	84		164	107	
See Fig. 6b	High Voltage Switching	260	65		260	130		112	28		112	56		92	23		92	46	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	96	24		66	33		96	24		66	33		96	24		66	33	
		524	187		494	289		316	118		286	175		278	105		248	149	
See Fig. 6c	High Voltage Switching	328	82	41	328	164		144	36	18	144	72		120	30	15	120	64	
	Transformer	168	98	76	168	126		108	66	50	108	86		90	58	44	90	70	
	Low Voltage Switching	96	24	12	66	33		96	24	12	66	33		96	24	12	66	33	
		592	204	129	562	423		348	126	80	318	191		306	112	71	276	167	
See Fig. 7a	High Voltage Switching	328	82		328	164		144	36		144	72		120	30		120	64	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	160	40		110	55		160	40		110	55		160	40		110	55	
		656	220		606	345		412	142		362	213		370	128		320	189	
See Fig. 7b	High Voltage Switching	384	96		384	192		160	40		160	80		128	32		128	72	
	Transformer	168	98		168	126		108	66		108	86		90	58		90	70	
	Low Voltage Switching	160	40		110	55		160	40		110	55		160	40		110	55	
		712	234		662	373		428	146		378	221		378	130		328	197	

* Electric Utility Engineering Reference Book, Vol 3, Distribution (1960), Westinghouse Electric Corp

Noise Level for Urban Subs Can Be

Plotting threshold curves for individual residential subs prevents excessive investment, reduces complaints

S. R. **LINDGREN**, Application Engineer, Allis-Chalmers Mfg Co, Milwaukee, Wis.

Needless expenditure for low-noise transformers or special sound barrier construction in large residential substations can often be avoided by establishing sound threshold curves for the site before the transformer is purchased. If complaints appear likely, such curves and a study of the frequency composition of the transformer noise may also help the utility engineer choose between prevention at the noise source by use of a special transformer, or cure by barriers and other external treatment, as the best method of alleviation.

Usually prevention is more expensive, except possibly for very large substations. Since low noise level transformers are very costly, the reduction required must be determined closely. Buying excessive quietness can waste thousands of dollars per unit. However, even with standard transformers, it is desirable to know in advance that a cure may be needed so the station can be designed accordingly.

Predicting complaints for a particular station is not simple, since it is impossible to forecast precisely how loud the noise will appear to a specific individual and what his reaction will be. However, the possibilities can be narrowed by determining a hearing threshold curve for the station. The curve, plus past experience, can be used as a criterion for the tolerable noise level.

The loudness of a specific sound to an individual depends on the sound pressure level, the frequency composition, and the presence of other sounds. Since the human ear cannot pick out a pure tone and exclude all others, background noise in a narrow spectrum on each side of the tone will mask the pure tone somewhat and, effectively, shift the threshold of audibility for it.

By determining the masking produced by background noise at a specific substation, an estimate of the audibility threshold for the area can be obtained. This provides a criterion for the sound pressure level and frequency composition than can be tolerated in a substation.

The value of this technique is illustrated by a case history.

A few years ago a Midwest utility planned to install a 125 Mw, FOA power transformer in a residential area. At first, it assumed a masonry barrier around three sides of the transformer would be necessary. Subsequent hearing threshold curves for the area showed that a transformer could be installed without a barrier with reasonable assurance that there would be no complaints.

Between 1 am and 4 am, background noise frequency analyses were made at several locations in the substation area, using an octave bank analyzer. The octave band analysis was then converted to a pressure spectrum level (Fig 1) which entails converting sound pressures for octave bands of frequency to sound pressures for bands one cycle wide, by the equation:

$$L_{ps} = P_w - 10 \log_{10} W$$

where P_w is the sound pressure in db of octave bands W cycles wide, and L_{ps} represents the pressure spectrum level in decibels.

For example, for the octave in band between 75 and 150 cps, total sound pressure measured on analyzer was 51 db. In other words, 75 components, each one cycle apart and each having a 32-db sound pressure, would have a 51-db composite level.

Once the spectrum level is established the background noise masking effect in db for pure tones can be found, from the empirically determined Fletcher-Munson curves (Fig 2). For a spectrum level of 32-db, masking is 13 db. Thus audibility of a 106-cps tone (mean frequency of the 75 to 150 cps octave) would be cut 13 db by ambient noise.

By adding the masking spectrum (Fig 3) to the Fletcher-Munson threshold curves which are based on zero background noise, an audibility threshold curve (Fig 4) can be obtained. Essentially the same curve can be arrived at from published critical bandwidth curves.

Although only background noise in a narrow band on each side of a tone produces any masking effect, a pure tone will be audible only if the composite strength of the background noise in the critical band is less than that of the tone.

Thus the threshold of audibility can be determined by totalling the background noise in each of the various critical bands. In Fig 5, this is

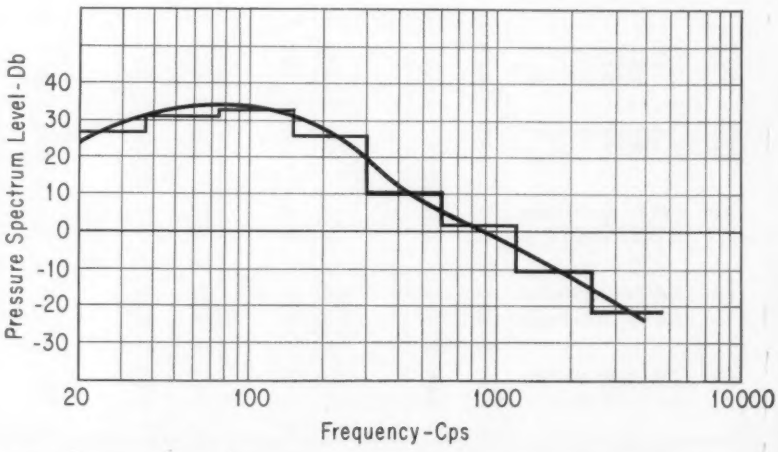


FIG 1—PRESSURE SPECTRUM LEVEL shows ambient noise for bands one-cycle wide at 2 am. Plot is obtained from octave band analysis at several locations

Predicted

done by expressing the critical bandwidth in decibels, the db value being the magnitude by which a pure tone must exceed the background spectrum level if it is to be audible. If the critical bandwidth decibel curve is added to the background spectrum level, the result is essentially the same spectrum curve obtained in Fig 4. This threshold approximates the hearing ability of the upper 5% to 10% of people; i.e., 90% to 95% of people would not hear this well. Field tests and studies of actual noise complaints indicated that tone components up to 10 db above this threshold are usually tolerated. The "complaint" curve in Fig 6 approximates the threshold for the upper 50% to 60% of hearing ability.

Harmonics Weak Above 600 Cps

The next step was to predict the magnitude of individual transformer noise components that might exist at houses near the substation, considering both noise frequency composition and attenuation with distance. Attenuation has been quite well established, theoretically and by tests on existing transformers.

Although frequency composition is more complex, transformer noise generally comprises a 120-cps fundamental with decreasing harmonics of 360, 480, 600 cps and up. Above 600 cps, harmonics are not appreciable.

Predicted pure tone sound pressure levels at nearby houses for an 87-db transformer are shown in Fig 5. Vertical bars represent the magnitude of each frequency component. Based on the previously discussed complaint criterion, an 87-db transformer would be intolerable in this installation, regardless of the frequency composition and would need a barrier to avoid complaints.

However, Fig 6 indicates that a 76-db transformer with the frequency composition shown would probably be tolerated without a barrier. A different frequency composition could extend some components into the complaint zone.

NEMA noise levels are based on the average of "A" network sound level meter measurements made close to the transformers. The "A" network attenuates components below 1,000 cps by varying amounts in an attempt to account for the difference in human ear sensitivity at low frequencies, especially at low sound pressure levels. The network cuts about 17 db from the sound pressure level of the 120 cps component, 10 db from 240 cps, 7 db from 360 cps, 3 db from 480 cps, 2 db from 600 cps, one db from 720 cps and so forth. The composite of these weighted components is the NEMA sound level.

Using the "A" frequency weighting network puts the various frequency components on a better com-

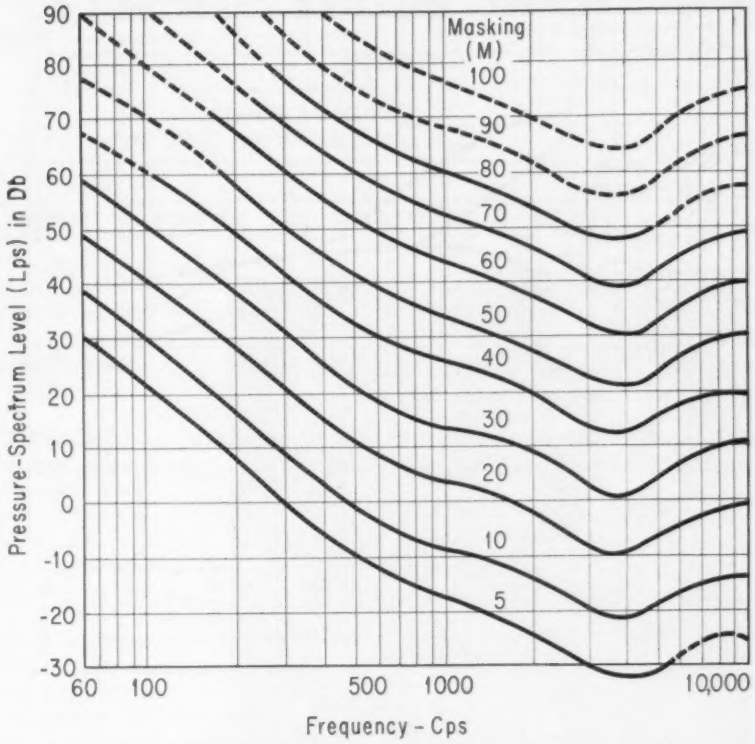


FIG 2—MASKING EFFECT OF BACKGROUND noise for pure tone frequencies can be found from curves above by using previously determined spectrum level

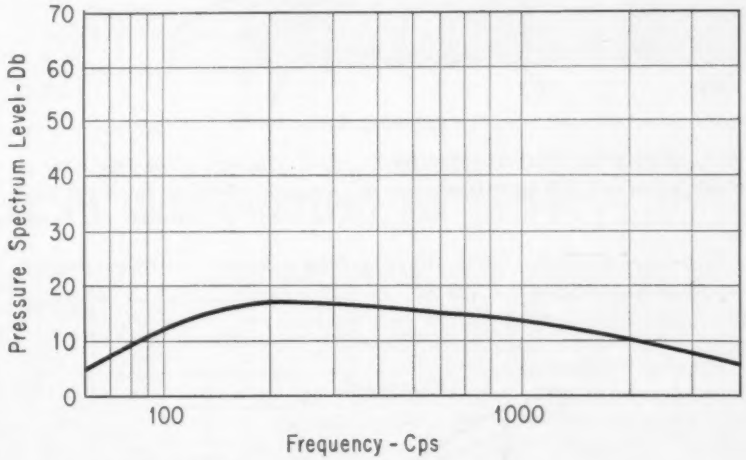


FIG 3—AMBIENT NOISE MASKING spectrum, taken at 2 am near substations site, shows variation of background noise effect with variation in frequency

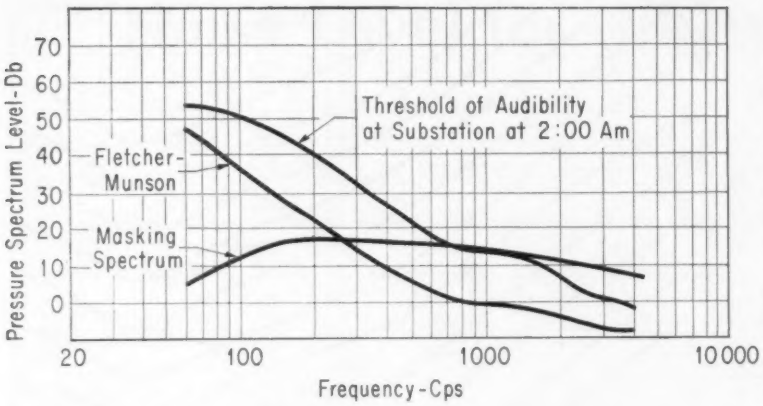


FIG 4—THRESHOLD OF AUDIBILITY CURVES are obtained by adding the 3 am masking spectrum to threshold curves based on no background noise being present

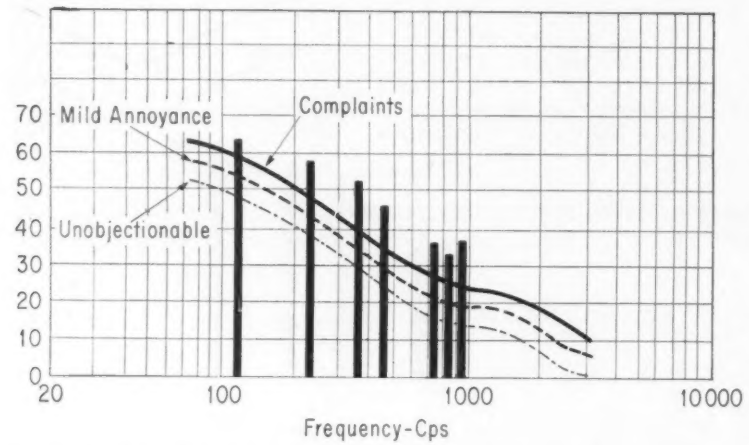


FIG 5—PURE TONE SOUND PRESSURE, in db, of 125-Mva, 87-db NEMA transformer, taken at 300 ft from transformer at 2 am extend will into complaint zone

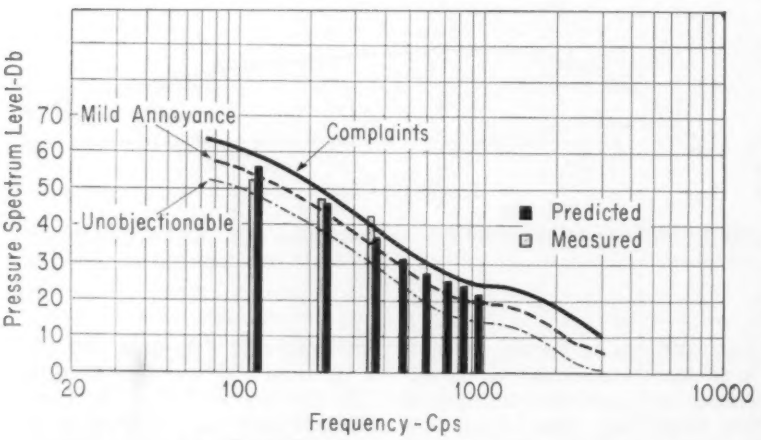


FIG 6—FIELD TEST OF 125-MVA, 76-DB unit show actual noise at 300 ft is very close to predictions. The 360-cps component varied greatly from moment to moment

mon audibility basis, but falls somewhat short, especially when masking is considered. Typical neighborhood background noise usually has its greatest masking effect at low frequency components. Fortunately, the composition of most transformer noise matches fairly well the typical complaint criterion curve.

To illustrate the importance of frequency composition, consider the following two examples:

If the 76-db transformer noise were pure 120 cps, sound pressure level would be approximately 93 db (76 = 93 — 17). With 300 ft of attenuation or about 32 db, sound pressure level of the 120-cps tone at the residences would be 61 db, slightly into the complaint zone.

On the other hand, if the transformer noise were predominately 600 cps, a 60-db NEMA transformer (64-db sound pressure level) might be in the complaint zone.

A 76-db transformer—designed with a special effort to avoid high frequency noise complaints—was purchased for the substation. After the transformer was in service, night noise measurements were made at adjacent homes. Fig 6 compares the analysis obtained with the predicted levels. Although pure tones are particularly capricious and difficult to measure at low levels, on the average, the results correlated reasonably well with the predicted values. No components above 360 cps were detectable at 300 ft.

The transformer was audible but did not appear objectionable. Pure tone strength often varies from point to point and, even at the same location, from one moment to the next. Thus one location was found to be alternately one of the quietest locations and then one of the noisiest. The noise would come and go at intervals of a few seconds. The analyzer clearly showed this to be the 360-cps component, represented by the maximum value shown on Fig 6. At its minimum, this tone would essentially disappear on the meter—a drop of about 15 db—and the transformer was almost inaudible.

The curves point out the importance of noise composition as well as average level in determining audibility at nearby residences. No pretext is made that the approach described is infallible, because of the unpredictable individual responses.

'Lift' Beats Climbing Stairs in Power Plant

An open-air "man lift" has been installed at the Big Sioux power plant of Iowa Public Service Co in Sioux City to assist mill operators and boiler operators in making their rounds. The "lift" was installed on the boiler room side of the wall between the boiler room and the mill house.

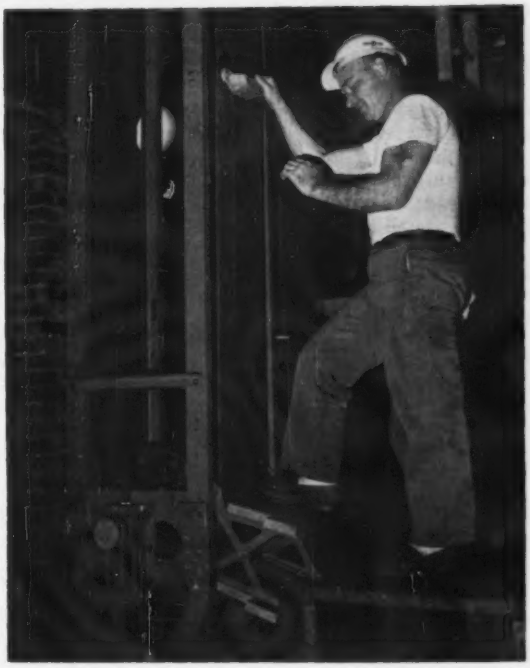
The lift can carry the men as high as 75 ft. There are four levels, the main floor, boiler operating floor, the fan floor and the uppermost coal bunker level.

While installed primarily to help boiler room operators and mill operators make their rounds, the lift has been discovered by other plant personnel who often find it convenient. It is rapidly eliminating use of stairways in that area of the plant.

The lift is driven by a 5-hp motor which can be turned off or on at any time by the person using it. An automatic safety switch shuts the unit off when a person reaches the point one ft above the uppermost level. Each step on the lift measures 12x14 in. There is a hand grip four to five ft above each step.

Steps are reversible, permitting continuous rotation. The top of the step on the upward flight is the bottom of the same step on the downward trip.

Openings at each level are about 30 in. in dia. Guard rails with self-closing gates were installed after the picture was taken.



Helicopter Helps in Converting to 115 Kv

For a 60 to 115-kv conversion project a Portland General Electric Co line crew converted 30 insulators in a half day with the help of a helicopter. Previously, the same crew changed 12 per day using gin poles.

In order to utilize the helicopter to best advantage the lineman initially freed the conductor from the old insulators on three successive poles. Hovering above each pole in succession, the 'copter lifted the conductor off the old insulator with a grappling hook. The lineman then lowered the old insulator to the ground without difficulty.

Next the hovering whirly-bird lowered the new 235-lb insulator gently in place, whereupon the lineman bolted it into position. Finally the helicopter maneuvered the grappling hook to replace the conductor on the new insulator.

The aircraft carried a loudspeaker, with an audible range of half a mile, for communication with the ground crew. The crew in turn used arm signals to direct the pilot of the helicopter for working the job.

Charts Coordinate Subtransmission

A. G. SHASTER, Dickerson, Md.

Aside from dollar evaluations, the most economical design for subtransmission lines and transformers will result from the coordination of all thermal, voltage, and other limiting parameters in all components for a given load concentration.

Comprehensive charts can be devised for this coordination. Because they set load distance limits for the handling of bulk loads, they coordinate the design of subtransmission with overall system design.

The charts can be used in the preliminary selection of plan possibilities because of their comprehensive comparison of various design considerations for both lines and terminal equipment.

The charts are based on a simple short-line equation for line-and-transformer physical performance, derived from standard voltage-impedance-turns ratio formulae:

$$E_S = \frac{M_{LE} S K_V FA}{V_K^2} - \frac{M_{TE} X \sin\theta}{M_{TB}} = \frac{E_R}{FA} \qquad (1)$$

For ease in calculation, equation **(1)** is best rearranged to the following form:

$$\frac{M_{LE} S K_V}{V_K^2} = \frac{E_S - \frac{M_{TE} X \sin\theta}{M_{TB}} - \frac{E_R}{FA}}{FA} \qquad (2)$$

Nomenclature is indexed in the accompanying box. Charts are prepared by calculating values from the right-hand expression of equation **(2)** for various combinations of F and A, the transformer "fixed" and "automatic" regulation ratios. Computer solution is very convenient for the preparation of a sequence of such charts for different parameters and combinations of parameters, especially where changes in the parameters can be expected due to advances in the art. It should be noted that F is the ratio of *boost* due to fixed taps, the *inverse* of the per unit *reduction* in tap voltage below nominal.

Nomenclature Used in Equations (1) and (2)

E_S	sending voltage, per unit
M_{LE}	line emergency loading, Mva
S	line distance, miles
K_V	line drop constant, for 90% power factor, at emergency conductor temperature, equivalent ohms
F	transformer fixed tap or reduced voltage ratio, per unit
A	transformer automatic tap ratio, per unit
V_K	line nominal voltage, in kv
$\frac{M_{TE}}{M_{TB}}$	transformer emergency/nominal (or base) rating ratio, per unit
X	transformer impedance rating, per unit of own base rating
$\sin\theta$	sine of the power factor angle
E_R	receiving voltage, per unit

Some examples of useful conclusions that can be drawn from a glance at the charts include:

1. The choice of a higher impedance transformer for another objective, for example, the reduction of short circuit duty, severely limits the voltage capability of the line and transformer combination.

2. The omission of fixed taps on the transformer leaves two alternatives:

(a) the loss of interchangeability of transformers between outlying and close-in locations, or

(b) the loss of voltage capability.

3. The full range of automatic tap voltage regulation is not effective because of the necessity of choosing fixed taps for symmetrical usage of automatic taps over the spread between peak load emergency and minimum load normal.

Charts are coded for the following four cases. The chart for the first case only is shown opposite.

1. (WPE-FOA-R2) Winter peak emergency, FOA transformers, 2-transformer radial

2. (WPE-FOA-N) Winter peak emergency, FOA transformers, network

3. (SPE-FOA-R2) Summer peak emergency, FOA transformers, 2-transformer radial

4. (SPE-FOA-N) Summer peak emergency, FOA transformers, network

Each case has a corresponding M_{TE}/M_{TB} ratio consistent with ASA ratings for the assumed load cycle, ambient temperatures, and governing transformer temperatures for the assumed loss of life. The transformer voltage drop is calculated for full loading of the transformer on the premise that the design is faulty if the line-and-transformer combination cannot handle rated load and provide the required voltage.

Example.

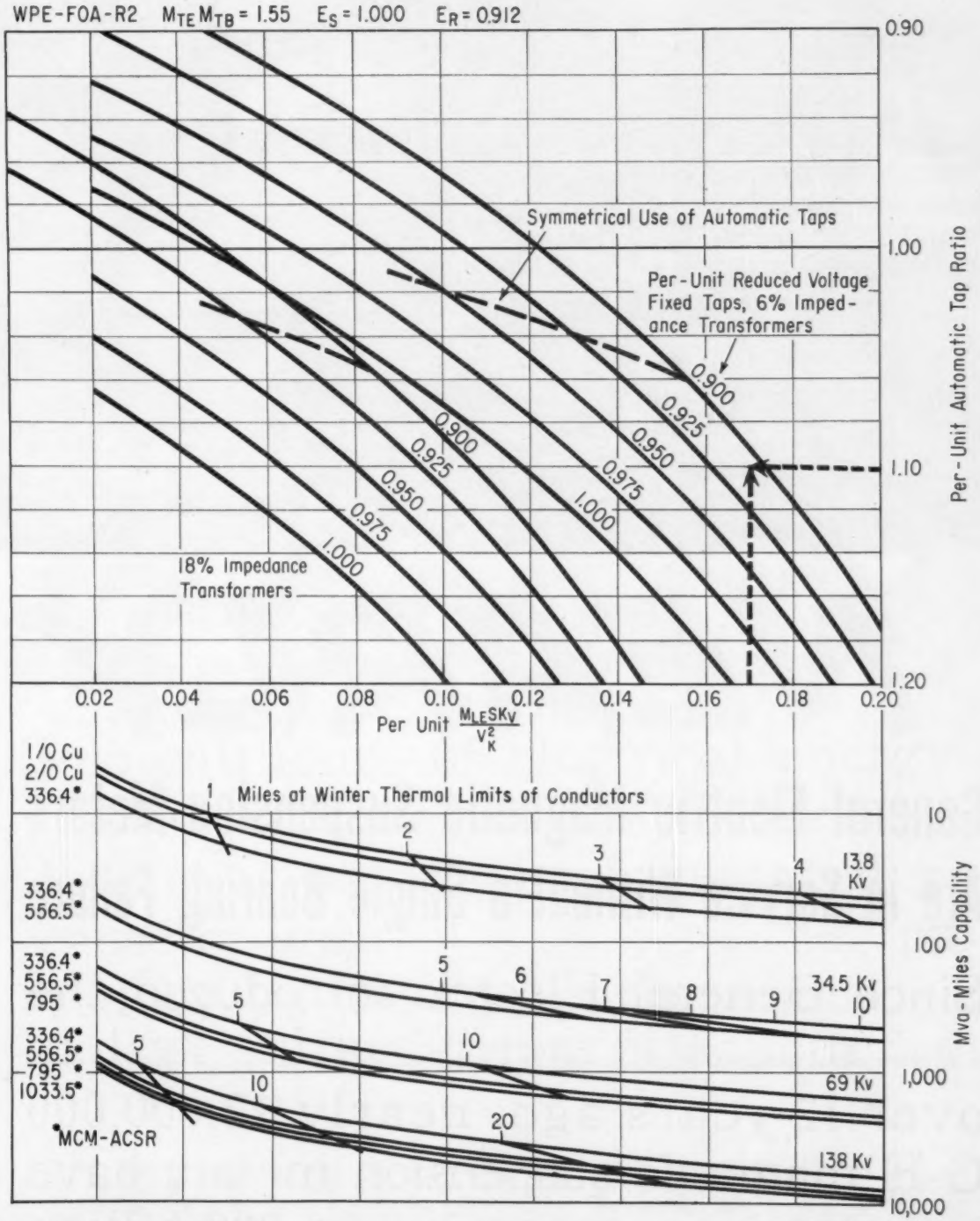
Assume the problem of supplying a winter peak load of 35 Mva over 10 miles at 34.5 kv overhead, using a two-line-and-transformer radial system and a conductor having a drop constant of 0.574 equivalent ohms at 90% power factor. The value with which to enter the WPE-FOA-R2 curve is:

$$\frac{M_{LE} S K_V}{V_K^2} = \frac{(35)\ (10)\ (0.574)}{1{,}190} = 0.170$$

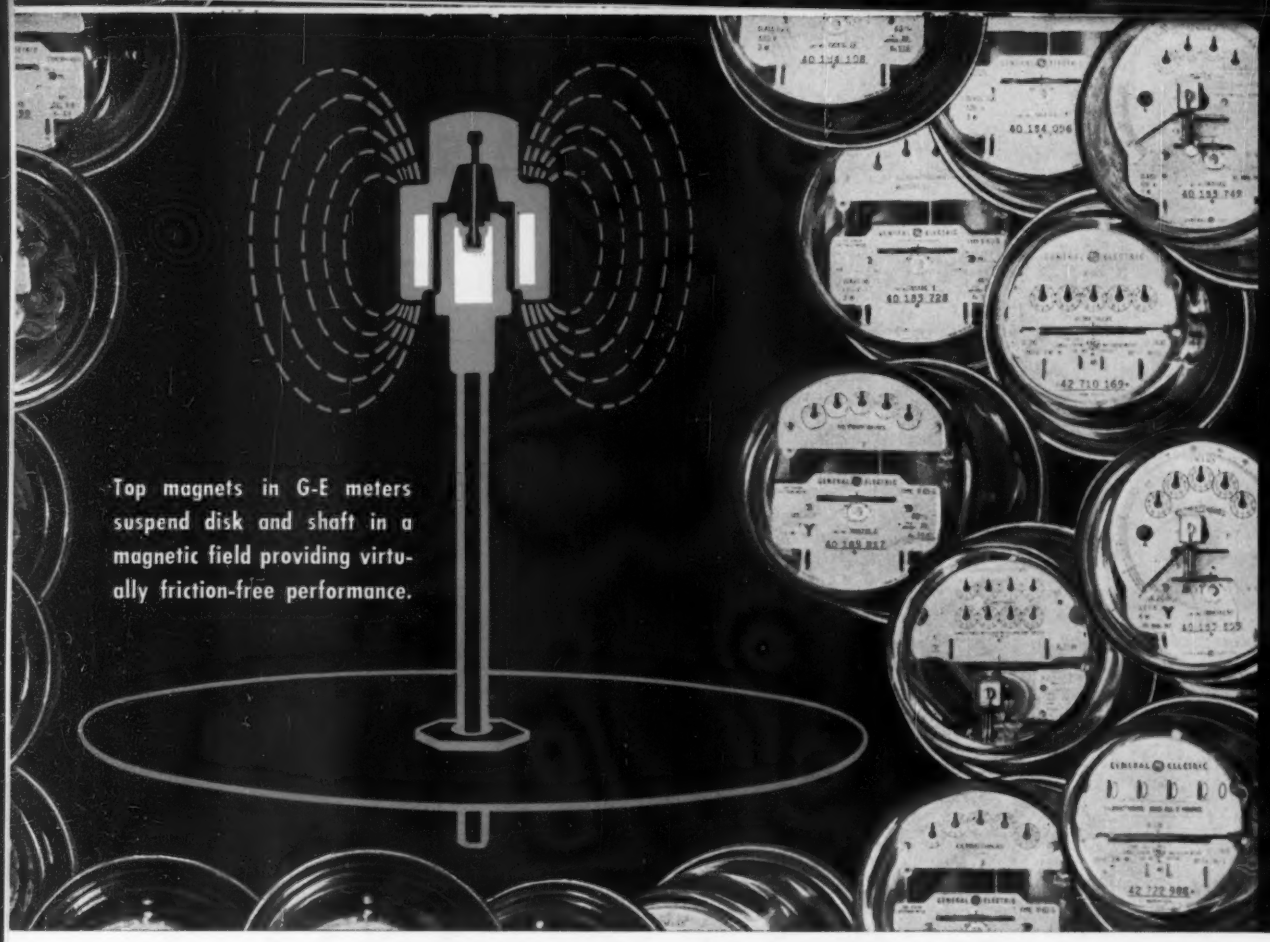
This voltage is barely within bounds for 6% FOA transformers, and it is deficient in voltage capacity using 18% FOA transformers. With 6% transformers, a 0.900 fixed tap or reduced primary voltage rating would be necessary to meet the permitted emergency under-voltage of 0.912 per unit. These observations are made on the assumption of the use of 10% automatic regulation and reading the curve where the capacity lines cross the horizontal line of A = 1.10.

The values of "miles at winter thermal limits of conductors" are shown to facilitate the gaging of the thermal utilization of the conductors chosen. Although engineering-management groups may differ on the parameters to use or the physical objectives to be met, the charts accurately indicate how the values relate to one another and can be adapted to any objectives.

With System Design



SUBTRANSMISSION VOLTAGE CAPABILITY charts are coded for four cases. Only the chart for (WPE-FOA-R2), which is Case 1 in the text, is included here. Transformer voltage drop is calculated for full loading of the transformer



NEARLY

General Electric Magnetic Suspension Meters Are in Service Without a Single Bearing Failure

Since General Electric introduced the first magnetic meter-bearing system over 12 years ago, nearly 12,000,000 G-E magnetic suspension meters have accurately measured over 200-billion

12,000,000

kilowatthours of electrical energy—without one magnetic suspension system ever having been replaced because of wear. This is reliability, proved by on-the-line performance. **Contact your G-E Sales Engineer for full information or write General Electric Company, Somersworth, N. H.**

713-07

METER DEPARTMENT

GENERAL ELECTRIC

PRICES ▶ **General Electric Co high-voltage switchgear department realigns catalogue prices** "to bring them more nearly into line with current market levels." The revisions, which are all downward, "will allow customers to plan ahead with more realistic catalogue prices on which to base their cost estimates," GE says.

Based upon the "previously published catalogue prices which were withdrawn Nov. 17, 1959," the reductions include: distribution-type circuit breakers, 40%; sub-transmission-type circuit breakers, 33%; isolated phase bus, 20%; indoor station cubicle equipment and indoor cell-mounted breakers, 15%; oil-filled single tank circuit breakers, 7½% (put in effect in May). All other changes went into effect Aug. 1 and affect equipment in the 14.4 through 345-kv class.

Reaction from utilities varied from "Catalogue prices don't mean a thing" to "It makes you wonder how they can cut published prices 40% and still not be below cost." But they hailed the trend toward making published prices more realistic, as did competing manufacturers. One said, "This will help straighten out the confused price picture."

There's no "white sale," concludes one large midwest utility which is trying to make up its own mind about the present price situation in the electrical equipment field. It studied price levels for the period June 1959 to June 1960 on 38 representative items, other than structures, used in transmission and distribution systems.

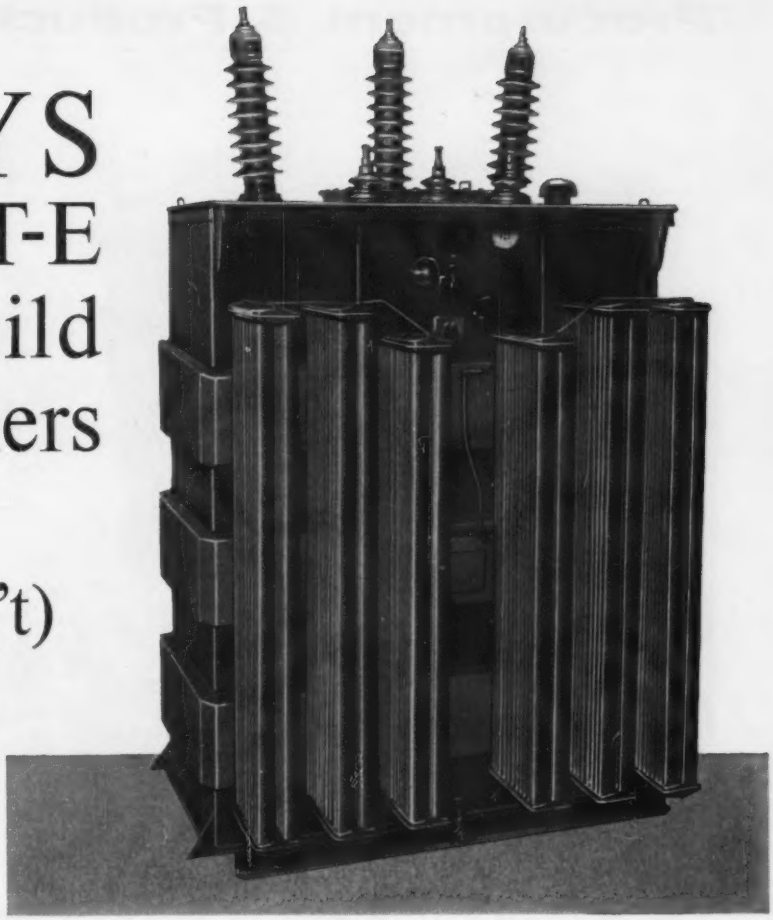
The results: Of the 38 T&D items, 16 showed actual price increases ranging from 0.7% to 18%; 12 showed no price change; and only 10 showed price decreases ranging from 2.8% to 45%.

OUTLOOK ▶ **For all industry additional price easing was reported** during July. In its monthly business survey, the National Assn of Purchasing Agents commented, "Many suppliers are adjusting book prices downward to more nearly conform with recent discounted offerings to buyers."

But the easier prices are not spurring inventory buildups generally, says NAPA. Some 52% of the PA's answering the survey questions said their inventories in July were the same as for the previous month, and 33% of the PA's said they were further reducing inventories. A typical comment was, "We are holding the line at minimum levels."

FUEL ▶ **Residual fuel oil prices continue to hold top interest** in New England where businessmen say oil import restrictions are forcing increases of 15¢ per bbl. They look for an early response to their pleas for some easing of the import quotas. Office of Civil and Defense Mobilization has the situation under study. Once the price increase takes full effect, the businessmen think that fewer oil firms will be giving discounts. As reported last week, Boston Edison Co figures the increase will cost an additional $1 million per year in its fuel bill.

9 WAYS that I-T-E could build transformers cheaper (but doesn't)



1. Use cheaper core materials. Losses would be higher or the transformers would be heavier. I-T-E continues to use grain-oriented silicon steel for maximum flux density.

2. Reduce the number of coil turns. This would save wire. But the transformers would be noisier, and losses would be higher. Who wants that kind of economy?

3. Skimp on tank construction. Would you want to risk tank leaks or transit damage? I-T-E double-welds seams inside and out . . . uses heavy gage metal that stands up.

4. Use substitute insulation. We could give it a fancy trade name and present it as new. I-T-E uses only time-proven materials—to insure longest transformer life.

5. Reduce or eliminate coil bracing. Short circuits can tear transformers apart inside. I-T-E braces them to withstand short circuit stresses.

6. Cheat on winding spacers. What's to keep adjacent turns from touching in case of a short circuit? Only the spacers. Cut down on them, and your transformer is on borrowed time.

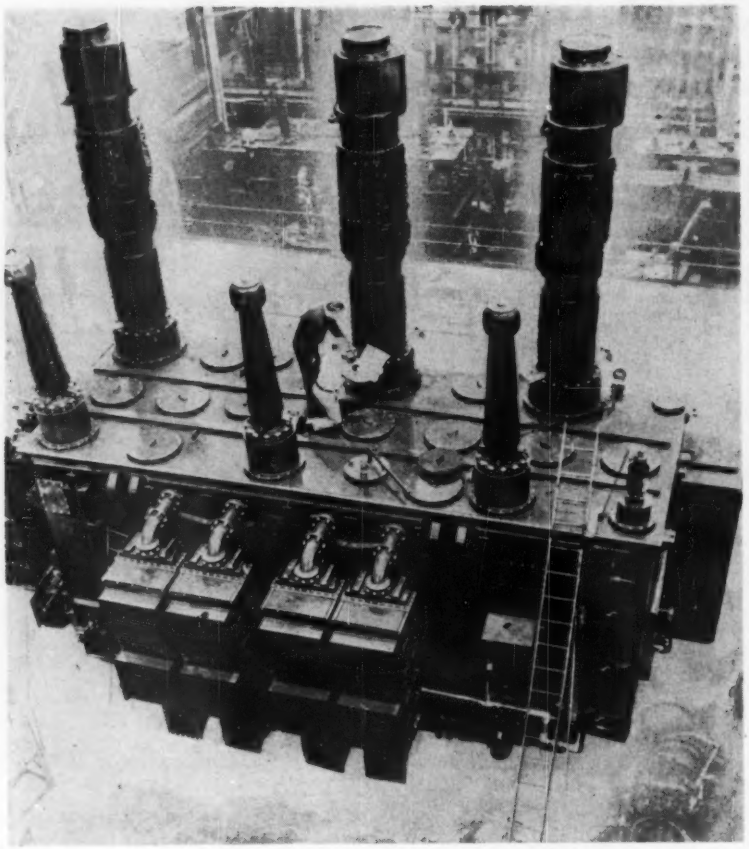
7. Wind discontinuous coils. We could quit winding all coils from continuous, unbroken wire. Wind each disc separately and braze together. And hope you never have a short circuit.

8. Use flimsy radiators. Trouble with radiators is they stick out like bat wings. Flimsy construction would cut costs. But damage could suddenly become a big, expensive problem.

9. Cut down on the finish. This would just cost you more in frequent repainting. I-T-E shot blasts inside and out. Applies one prime coat and two finish coats. Keeps rust out.

Bulletin 5802-1A covers I-T-E transformers in detail. Write I-T-E Circuit Breaker Company, Dept. TR, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY



Big LTC Transformer Built

General Electric Co has shipped to Public Service Electric & Gas Co four 300-Mva autotransformers with the largest bushing-mounted load tap changers the firm has ever supplied. One of them is shown (above) during assembly.

The LTC equipment differs from the conventional type in arrangement of contactors. They are located on top of the common, low-voltage bushings instead of in a separate compartment on the end of the transformer. This eliminates need for a series transformer and permits smaller dimensions, as much as 10% lighter weight, and up to 15% lower losses for representative units, says GE. The load-tap changers are ideal for autotransformers, adds GE, particularly in transmission-tie applications.

The New Jersey utility is installing two of the units near Trenton, one near Elizabeth, and the fourth near North Brunswick. Each weighs 250 tons, is 300-Mva, 230-kv, and will tie the utility's new 230-kv transmission into the existing 138-kv system. Two more are on order.

Core-type construction of the wye-wye units permitted them to be built without a delta-tertiary winding, resulting in reduced manufacturing expense and lower prices to Public Service.

First of this type of LTC arrangement units have been in service since 1943. GE foresees future application of bushing-mounted LTC's to the highest-rated transmission tie transformers.

Westinghouse Gears for Larger Unit Construction

Westinghouse Electric Corp has contracted to build a 600-Mva, 20 to 138-kv power transformer for a midwestern utility company.

The transformer will weigh about 300 tons. It will be 24½-ft high, 26-ft long, and 20-ft deep.

The unit will be built at the company's new plant in Muncie, Ind., now under construction. Increased facilities there will make it possible to build such large units. Production at Muncie wil start in the latter part of 1961; the transformer will be delivered in June, 1962, but design work will begin immediately.

Transformer Standards Compiled in One Book

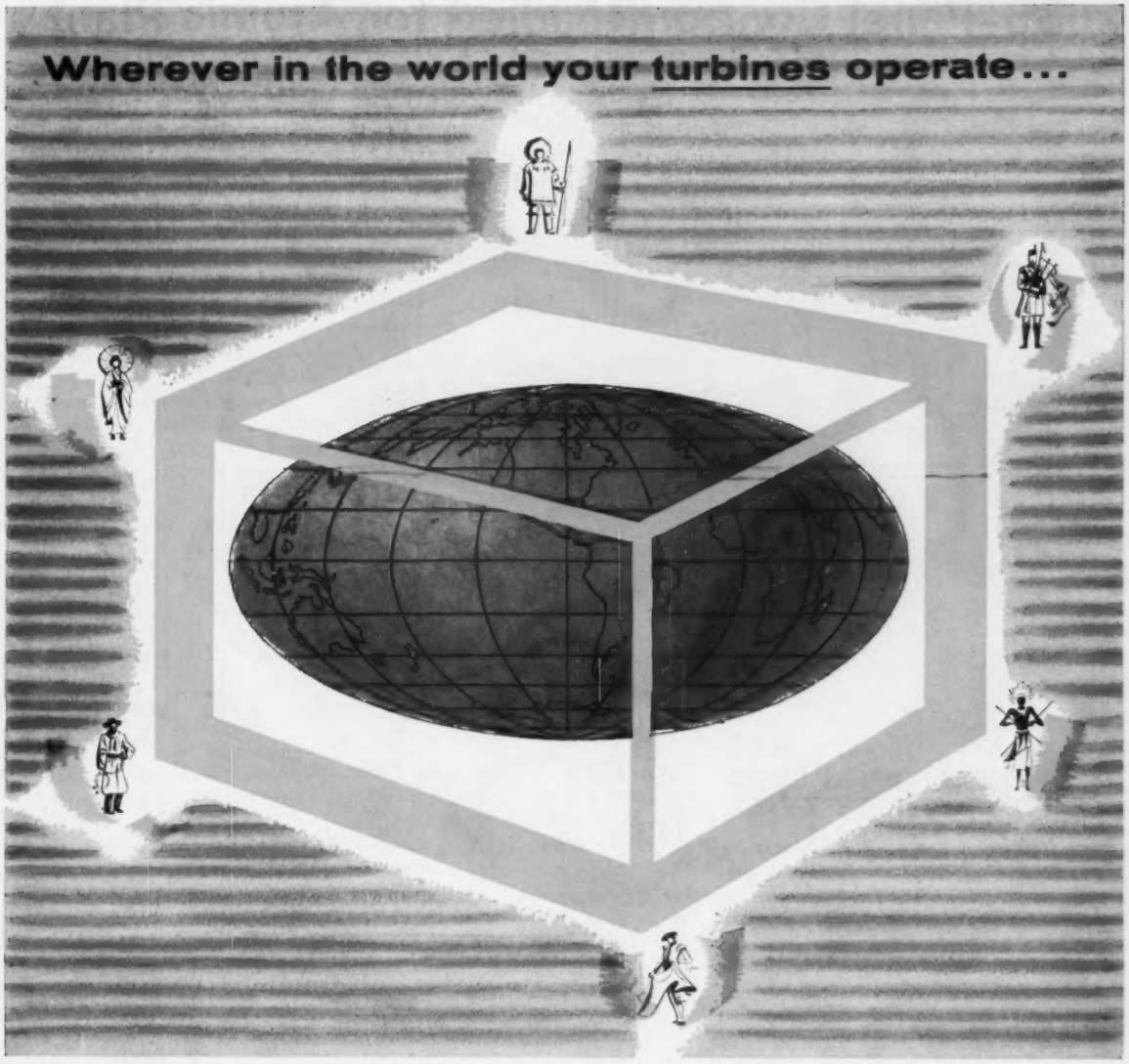
All present transformer standards have been compiled in one new publication issued by National Electrical Manufacturers Assn, as result of several years of effort put forth by members of the Transformer Section. NEMA gives credit also to the "generous cooperation" of allied industry organizations. The project represents several years' work.

Included are standards for distribution, power and regulating transformers, regulators and reactors, and such special-purpose transformers as those used in unit substations, electric arc furnaces, and industrial rectifiers. Material is in 20 sections, including test code, terminology, apparatus standards.

Text combines information on transformer standards approved by American Standards Assn and those NEMA transformer standards which still are awaiting ASA approval. The publication can be used as a single, over-all documentary, as well as a guide to ordering those sections applying to specific transformers.

The new book, "NEMA Standards Publication — Transformers, Regulators and Reactors; No. Tr 1-1960," is available from NEMA headquarters, 155 E 44 St, NYC 17, @ $1.00.

(*More News of Manufacturers p* 64)



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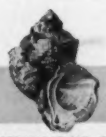

AN INTERESTING FACT!
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Around the world, Shell Turbo Oil is available—under the same brand name and providing the same outstanding performance. This is assurance that your customers abroad will enjoy the superior turbine lubrication that domestic customers insist upon.

Shell Turbo® Oil provides these 4 outstanding reasons for its acceptance as a top-rated lubricant for utility, industrial and marine turbines: (1) It has exceptional oxidation stability for maximum service life. (2) It separates readily from water. (3) It protects against rust. (4) Its performance does not vary—make-up oil is identical to the original charge regardless of time of purchase.

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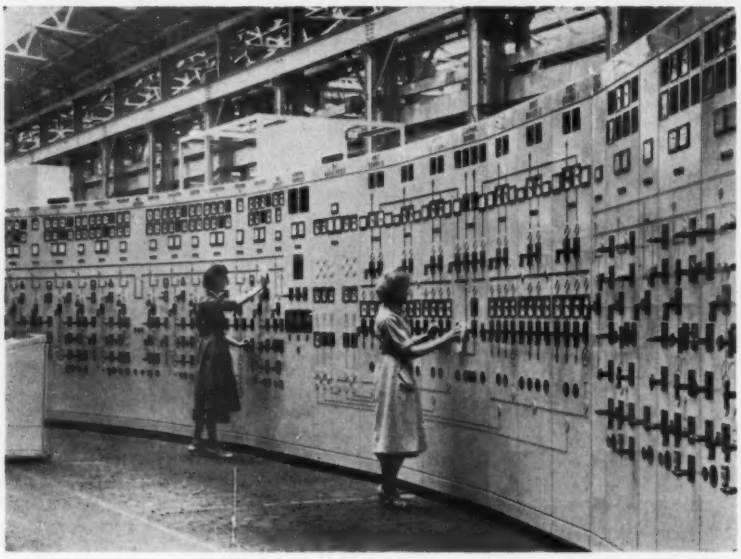
SHELL

33-Panel Control Readied for Atomic Plant



The 52-ft-long, 33-panel control board (left) is receiving final polishing touches at English Electric Co's Stafford plant. It will serve the 500-Mw atomic power plant at Hinkley Point, Somerset, England.

The board will control six 93.5-Mw main generators, three 33-Mw variable frequency generators used to power gas circulators, dc auxiliaries, and 14 275-kv, 7,500-Mva air-blast circuit breakers in the outdoor switching station.

Hinkley Point is being built for Britain's Central Electricity Generating Board to power the national grid. Besides EE, Babcock & Wilcox and Taylor Woodrow Atomic Power Group make up the consortium which is supplying equipment for it. Scheduled completion date is 1962.

GE, Toshiba Sign Steam T-G Agreement

Under a license agreement signed by General Electric Co and Toshiba (Tokyo Shibaura Electric Co), Toshiba will build GE-designed 265-Mw, 50-cps cross-compound steam turbine-generators. They will be identical to a GE unit recently completed for Tokyo Electric Power Co's Yokosuka plant (below).

The $53-million turbine at Yokosuka has an initial and reheat temperature of 1,050F and a 2,400 psi initial pressure. It is principally coal-fired, but can use oil also. Tokyo Electric Power has started to build a second unit of the same capacity on the 185-acre plant site. It is scheduled for October, 1962, completion.

The agreement just concluded between GE and Toshiba covers a 15-year period, provides 3% royalty to General Electric. It is similar to other contracts GE has made with Toshiba in the turbine-generator field, as far back as before World War II. It includes "no limitation in the area of markets" for Toshiba, GE comments.

GE also has license agreements in the switchgear and transformer field with the Japanese firm and has a 7.1% share of ownership in the company.

MANUFACTURERS BRIEFS

Allis-Chalmers Mfg Co's new ceramic fuel development laboratory, recently completed at Greendale, Wis., is being used to develop techniques for cladding ceramic fuels with corrosion resistant materials. Various methods of bonding the cladding material to ceramic fuel have also been developed and evaluated in the lab. New developments will be incorporated into the Pathfinder atomic power plant being constructed by A-C for Northern States Power Co.

Elastic Stop Nut Corp of America's Elastimold Div has opened its new Hackettstown, N. J., plant. Products will include molded rubber connectors and transformers.

Electric Storage Battery Co has purchased the nickel-iron alkaline battery business of McGraw-Edison for an undisclosed amount of cash. ESB termed the acquisition "a logical and desirable further step in the diversification of ESB's basic business—the manufacture of packaged power devices."

Jasper Blackburn Corp has begun construction of a 10,000-sq-ft addition to 100,000-sq-ft St. Louis plant.

Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Timely? Many complex factors shape the final decision to proceed with your expansion plans...and timing is an important one. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers designs and builds all types of power plants—steam-electric, gas turbine, combined cycle, nuclear, and hydro-electric. From Pre-Engineering through design and construction, Kaiser Engineers provides complete, one-company service and ingenuity based on years of experience.

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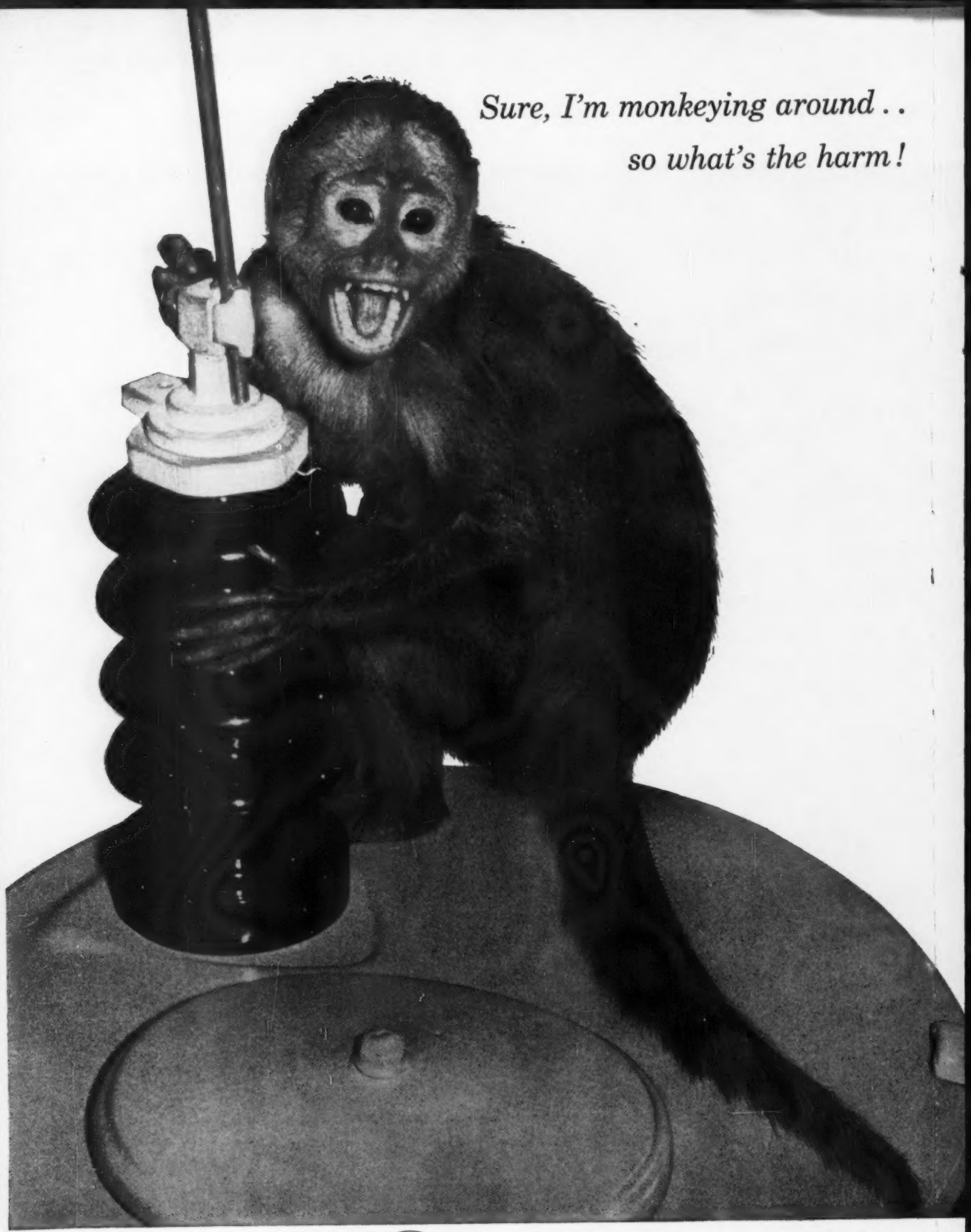


Live monkey, photographed by
Taylor Beech, Pennsylvania
Transformer staff photographer.

McGRAW EDISON

PENNSYLVANIA TRANSFORMERS pt

PENNSYLVANIA

New "Sky-blue Covers"

on Pole Star® Distribution Transformers prevent animal-caused outages ... and protect wildlife!

Whether monkeys, parrots, sparrows or squirrels ... members of the wildlife community who pause atop Pole Star Distribution Transformers can now make contact between transformer cover and bushing terminal without harming themselves and *without causing line-to-ground short circuits.*

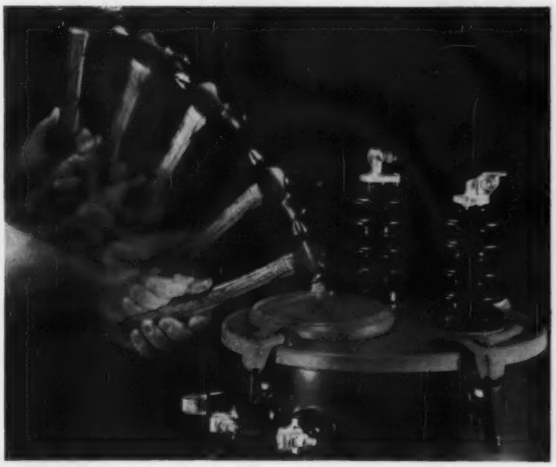
Pole Star's new Sky-blue Covers are the reason. Insulated by means of specially applied polyvinyl-chloride, Sky-blue Covers eliminate the need for bushing caps, terminal taping and other devices for preventing animal-caused outages. Thickness of the insulating finish is varied to provide an *extra margin* of dielectric strength in all voltage classes.

Easy identification of cover-insulated transformers in storage and on poles is made possible by the distinctive color of Pole Star's Sky-blue Covers.

Sky-blue Covers will be standard on all pole-type Pole Star Transformers with cover bushings. For additional information or a quotation on specific requirements, contact Distribution Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

No external bushing clamps on new Sky-blue Covers

A bonus feature of Pole Star's new Sky-blue Covers is the absence of external bushing clamps. This eliminates potential dirt collectors and sources of corrosion, and also improves transformer appearance. The internal ring-clamps assure uniform pressure at all points for maximum gasketing effectiveness. Gaskets are made of nitrile rubber—a long-time standard of Pole Star Distribution Transformers because of outstanding resistance to oil, heat, cold, moisture, dust, and other detrimental conditions.



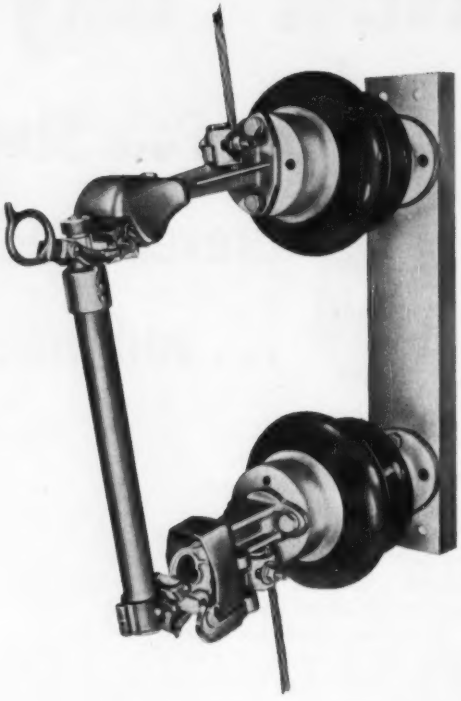
Outstanding resistance to impact, scraping, corrosion

Repeated blows from a hammer illustrate the ability of Sky-blue Covers to withstand impact without chipping. In other tests, Sky-blue Covers were blasted for three minutes with steel grit without exposing any bare metal—truly *amazing* resistance to abrasion! Also, Sky-blue Covers were in better condition after *3000 hours of exposure to salt spray* than uninsulated covers were after but 1000 hours. Such ruggedness eliminates any necessity for "kid-glove" treatment during handling and installation.

DISTRIBUTION TRANSFORMERS

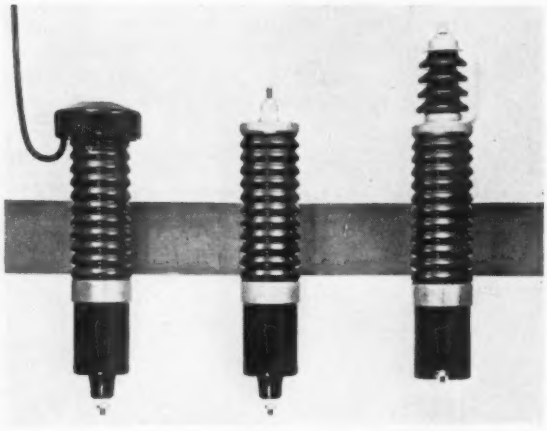
Power Fuse . . .

. . . with silvered contacts clears circuits under minimum or heavy faults without pitting or burning the contacts. The contacts, held under high pressure, are self-wiping with each operation. Type P fuses, furnished in 7.5, 15 and 23-kv, 100 and 200-amp ratings, have interrupting capacities from 4,000 to 10,000 amp.
A. B. Chance Co, Centralia, Mo.



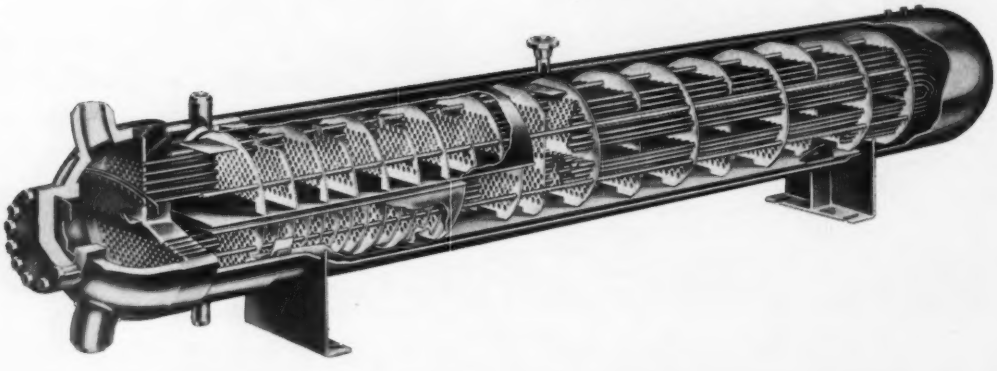
Valve Arresters . . .

. . . in ratings from 3 to 18 kv contain silicon carbide valve elements for high thermal capacities and low discharge voltage characteristics. Each distribution arrester has a series of short quench and isolating gaps in unit structures with electrostatic shielding to obtain low impulse spark-over.
Joslyn Mfg & Supply Co, 155 N Wacker Dr, Chicago 6, Ill.



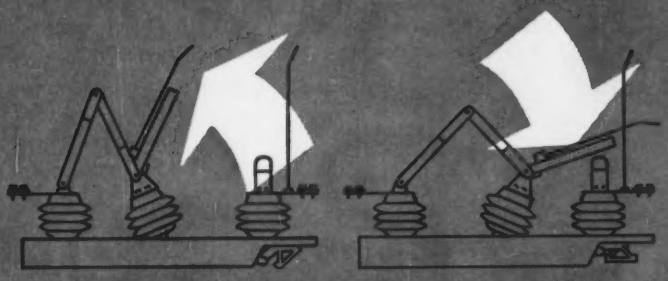
Feedwater Heater . . .

. . . has a new type of welded joint between the tubes and the tube sheet. The tubes are welded to a cladding over the tube sheet; the cladding is made up of a layer of nickel and layers of nickel-copper alloy welded onto the surface of the tube sheet. The inlet chamber of the feedwater heater is hemispherical.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



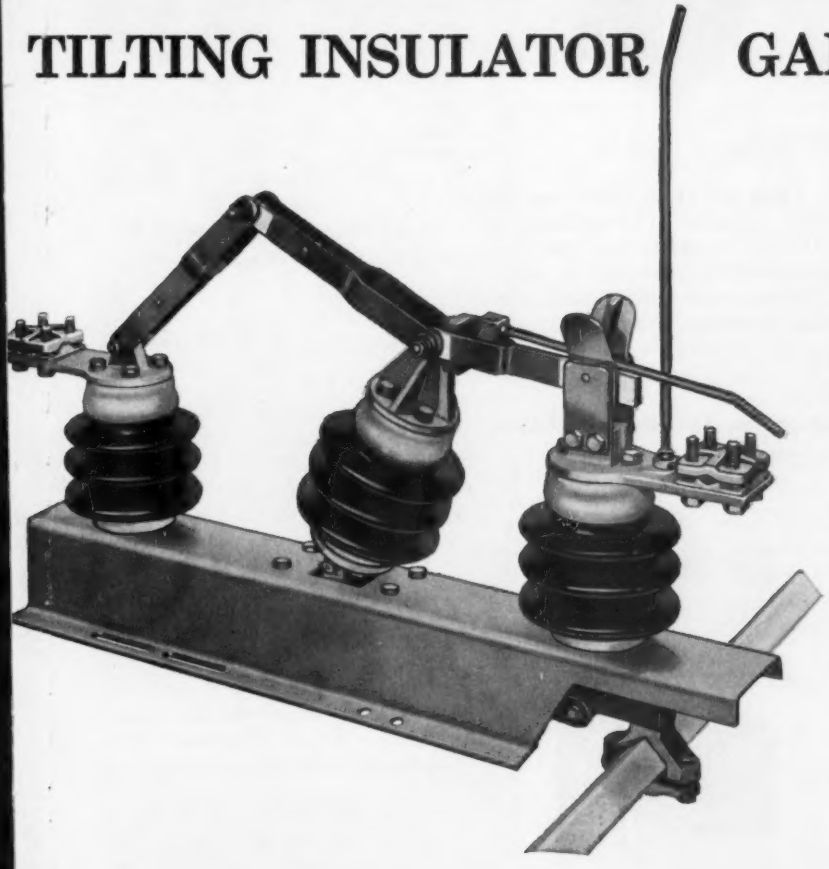
Special **KEARNEY** design for

smooth opening and closing



despite crossarm warpage

TILTING INSULATOR GANG SWITCH



- Switch works smoothly even when crossarms are warped out of alignment, horizontally or vertically, because the specially designed interphase shaft clamp compensates for any structural distortion
- Double leverage frees switch blade of heavy ice coatings: "pry-out" blade action plus toggle action of operating linkage on the tilting insulator
- Longer maintenance-free service in corrosive atmospheres—and in unusually frequent operation—because there is no flexible blade shunt to wear out
- Extra long jaws: adjustment for blade travel need not be critical . . . silver blade to jaw contacts
- Tilting insulator supported by Oilite bearings
- Easy installation . . . interphase shaft can be lifted into clamps after switch is in position

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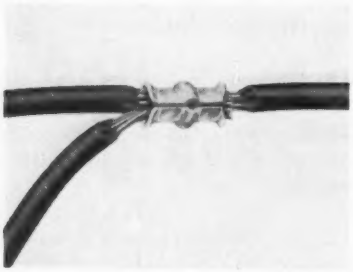
Motor . . .

. . . is smaller and lighter than preceding models. Greater output is due to the allowable temperature rise of 65C. Totally enclosed, the type "D" motor is for locations with dust or dirt. Units for 2 or 3-phase supply to 650 v are available in ratings from ½ to 40 hp.
English Electric Export and Trading Co, 750 Third Ave, New York 17, N. Y.

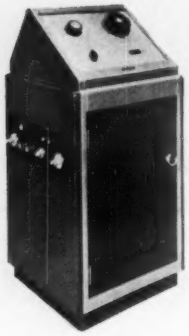


Compression Taps . . .

. . . for copper conductors are available in nine sizes for joining two No. 10 through two No. 1/0 wires or for tapping smaller sizes from wires as large as No. 3/0. Each C Tap bears a color band to indicate the proper die for the installing tool required.
Thomas & Betts Co, 36 Butler St, Elizabeth 1, N. J.

EDP System . . .

. . . makes scientific computations twenty times as fast as its predecessor. The IBM 7074, which also processes business data, is furnished in building-block modules so the user can install a medium-size or large computer system. An IBM 7070 system can be converted to the new one by replacement of three modules.
International Business Machines Corp, 112 E Post Rd, White Plains, N. Y.

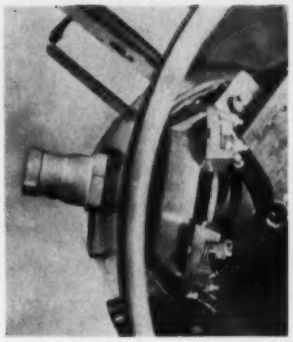


CT Tester . . .

. . . puts out 10 to 4,000 amp and offers a selection of 23 intermediate-step current outputs. The type AL-2 current transformer testing equipment, which operates in conjunction with the Knopp Transformer Comparator, tests CT's in ratings to 2,000 amp from light load through 200% load.
Knopp Inc, 1307 66th St, Oakland 8, Calif.

Utility Pole . . .

. . . of prestressed concrete has an octagonal cross-section and has proved to be equally strong under deflection in all directions. The pole, reinforced and prestressed with cables, has a hollow center.
Florida Prestressed Concrete Co, Inc, Box 11476, Tampa 10, Fla.



Switch . . .

. . . for distribution transformers is externally operated. The series-multiple switch permits changing to another primary voltage while the transformer is deenergized. It is available for conventional, protected and rural-line single-phase transformers for dual ratings of 2.4/7.2 to 7.2/14.4 kv, 5 through 167 kva.
Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 33, Mo.

More New Products

High-temperature insulation for piping protects against damage and weather. Removable Kaylo-Klad pipe insulation, which has an aluminum jacket, can be used with heats to 1,200F.—Owens-Corning Fiberglas Corp, Berlin, N. J.

Cram-it **expansion bolts** for installation in concrete and similar materials are available in a variety of sizes and metals. The greater the pull on one of these bolts, the tighter it holds.—Wej-it Expansion Bolt Co, Kingston, N. Y.

Permacel 870 polyester film pre-set **electrical tape** that does not have to be cured by baking has a thermoset adhesive, which makes it resistant to electrical varnishes. It withstands temperatures to 150C.—Permacel, New Brunswick, N. J.

Two-pole, 100-amp type TC100L **plug-in breaker** serves as the main breaker for a 120/240-v distribution panel, but fits into the space for two branch-circuit-breaker poles.—Zinsco Electrical Products, 729 Turner St, Los Angeles 12, Calif.

ALCOA ALUMINUM
ACCESSORIES ROUNDUP

Certainly you can get Jiffy Joints in a complete range of sizes!

Has the single aluminum sleeve concept been applied to a wide range of ACSR conductors?

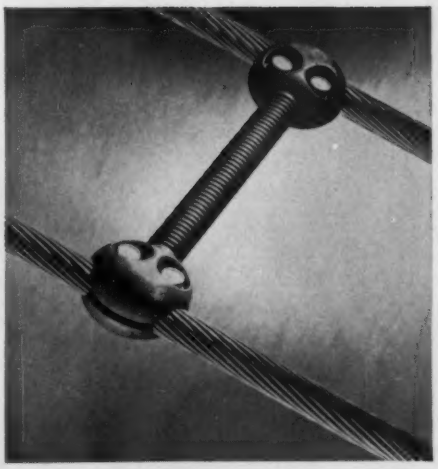
It certainly has! Just take a look at Jiffy Joints—our trade name for full-rated (mechanical and electrical) single-sleeve joints for ACSR conductors.

With Alcoa Jiffy Joints you can join conductors from No. 4-6/1 through 477,000 CM 18/1 as well as alloy conductors of the same diameters. All told, you can select a Jiffy Joint from our catalog 500 series, designed for any common, single-strand core ACSR conductor.

What else besides range of sizes is important? How about holding power? These aluminum Jiffy Joints properly installed will hold effectively. Laboratory tests prove they will develop 95% of the rated strength of the conductor—exactly what's expected from any full-tension joint.

Jiffy Joints install easily, too. There's no need to cut back the aluminum strands and separately join the steel core. Jiffy Joints have an internal taper at the sleeve end for easy insertion of the conductor. This is particularly important in hot-line work.

More facts: Every Jiffy Joint is prefilled with a soft filler compound, which is placed along the inner wall to allow wires to be positively inserted all the way to the center stop. This compound fills the interstices, completely sealing the compressed joint.



Spacers for EHV bundled conductors!

We've been building, testing and examining a variety of bundled conductor spacers over the past years. Out of this work has developed a closed helical spring design with oval clamps—now being installed by the New York State Power Authority on hundreds of miles of 795,000 ACSR 26/7 conductor, to be operated at 345 KV on a tie-line connecting the new Niagara and St. Lawrence Power Projects.

This spacer offers unusual strength and fatigue resistance. It provides column strength to resist short circuit forces and is flexible in all other directions.

In fact, our thorough evaluation and testing in the laboratory and field installations of a wide variety of designs lead us to believe that this is the best, so

(Continued on next page) ▸

far. This is a spacer that will stand up to all the expected installation strains.

Current consideration of three-conductor bundles has led to extension of this type of design to a novel and very efficient "tri-spacer."

Our engineers will be happy to discuss our experiences and findings with you.

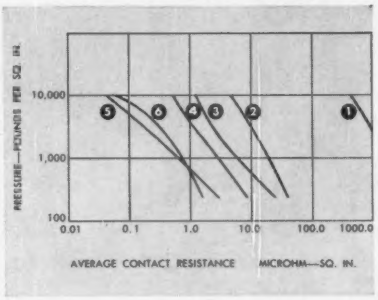
How to get low-resistance joints out of a squeeze bottle

The squeeze bottle contains Alcoa No. 2 Electrical Joint Compound, a distinctive (and patented) fluoride-containing compound that dissolves the oxide film on aluminum and seals the joint against moisture.

But there's a big difference between this and many other compounds containing fluoride. Some such compounds can result in a pitting attack of the aluminum surface, with localized action going deep into the surface. Not so with No. 2 EJC. This compound produces a light surface etch, needed for cleaning—but no deep attack. Years of use and testing lead to the following conclusions about the merits of Alcoa No. 2 EJC:

1) Lower resistance in stacks of bus conductors than with comparable joints using other compounds.
2) Stability with load cycling.
3) Efficient, trouble-free service—bus joints that are free from corrosion and low in resistance.

A performance report—six pages filled with details, charts and diagrams telling about Alcoa No. 2 Electrical Joint Compound experience and testing—is available through your Alcoa-Rome salesman.



For tests, using stacks of ¼-in. x 1-in. E.C. aluminum bus bars, the curves are as follows: (1) no treatment; (2) a metal dust in grease; (3) an inhibitor, abraded; (4) Alcoa No. 2 EJC, no abrasion; (5) Alcoa No. 2 EJC, abraded with emery; (6) silver-plated bus. Each resistance was measured across 10 interface contacts.

New clamp gripper tool

This new clamp gripper tool is for use with Alcoa Catalog 396.6 and 392.6 parallel groove clamps and a hot line "shotgun" stick. Start with the clamp positioned in the gripper with the bolt head engaged in the drive socket. End up with the clamp on the line and the gripper tool firmly held by the stick so it can't fall or get out of control. This leaves the inexpensive parallel groove clamp doing the electrical job for which it has been designed and tested. Simple. Sure. Efficient. All the steps are carefully pictured and explained in a recently issued two-page bulletin. Tell us you'd like a copy.

Reminder: Get the facts on Jiffy Joints, Spacers, No. 2 EJC and the new gripper tool —soon.

ROME CABLE
DIVISION OF **ALCOA**

This is an advertisement.

How Utilities Raised $888 Million in First Half

Common Stock	$105,265,000
Preferred Stock	$ 89,617,000
Bonds	$693,150,000

Source: Ebasco Services, Inc.

Outlook for Second Half Financing

Report on **Financing**

The electric utilities sold $888 million in new securities in the first half, adding to their books roughly one dollar of every five raised by US corporations. Thus, utilities, as usual, remained heavyweights in financial markets. Still, their first half offerings trailed 12% behind first-half volume of 1959. Nothing out of the ordinary, the decline was expected. The electric companies entered the second half with about $900 million more to raise by year end. That's how much more they need to satisfy 1960 new money requirements of $1.8 billion. And the utilities will be going after this new money in markets that remain a puzzle for all. Here's the outlook:

- **Despite some recent easing, pressures on interest rates remain high.**
- **Interest rates on long debt,** therefore, should move in a narrow range close to present levels.
- **Preferred stock yields will drop slightly,** in sympathy with somewhat easier money, and with stepped up private placements with insurance companies.
- **The cost of common should remain near its appealing low,** about 6% (before expenses) on an earnings price ratio basis—a pleasant prospect.

A Glance at the First Half—How Utilities Raised $888 Million

As usual, the utilities were busiest in bond markets. Busy indeed. A tremendous bond float (chart above) drew in $693 million in the first half. That's a full 78% of all new money the utilities attracted—this despite interest rates that stood near record highs. This heavy concentration on debt, however, is hardly abnormal. In 1957, the year the electric companies raised a record $2.6 billion in new money, they relied on long-term debt for 82% of it. And the proportion in 1958, 78% nearly equalled the 1957 figure. All this action in bond markets has left its mark on capitalization ratios. Electric companies' proportion of debt to total capitalization has increased steadily, from 50.6% in 1954 to 52.4% by 1959.

The utilities have been able to hold their debt proportion of capitalization close to the traditional 50% level despite enormous debt offerings ranging from 60% to 80% of each year's financing. They do it by retaining about $400 million a year (which increases the common stock proportion of capitalization) and by gradually retiring their long term debt through sinking fund reserves.

Of all the money utilities raised in the first half, only $3.15 million (less than 0.5%) was for refunding of old bond issues. This reflected the continuing high level of interest rates during the first half. In general, interest rates must drop from ¾% to 1% below the rate on an outstanding issue to make refunding economical. The dearth of refundings, so far this year, is no surprise.

The first half's one big surprise came in preferred stock offerings. Preferred issues, which have generally declined over the years, were back in fashion. Preferred offerings, in fact, posted the only dollar gain over '59 first-half volume. The industry moved $89.6 million worth of preferred stock—a $13-million increase over last year. And most of it, surprisingly, was placed privately; a full $85.7 million, or seven times last year's volume. Not a dollar of preferred was offered publicly, according to a mid-year survey compiled last month by the Business Management and Financial Department of Ebasco Services, Inc.

This big swing to private placements of preferred stock is one worth watching. No doubt it was nurtured, in part, by enactment of the Life Insurance Co Income Tax Act of 1959. The new Act awards certain tax concessions on the dividend income of insurance companies (as opposed to their interest income). This opens up a vast new preferred market for the utilities—one that has virtually dried up for utility bonds. The result could be lowered preferred costs, and a further narrowing between preferred and bond yields.

The electric utilities offered $105 million in common stock in the first half, about one-third of 1959 volume. Of this $105 million, some $68 million was offered to the public. The remainder, $37 million, was placed in the hands of stockholders through subscription rights.

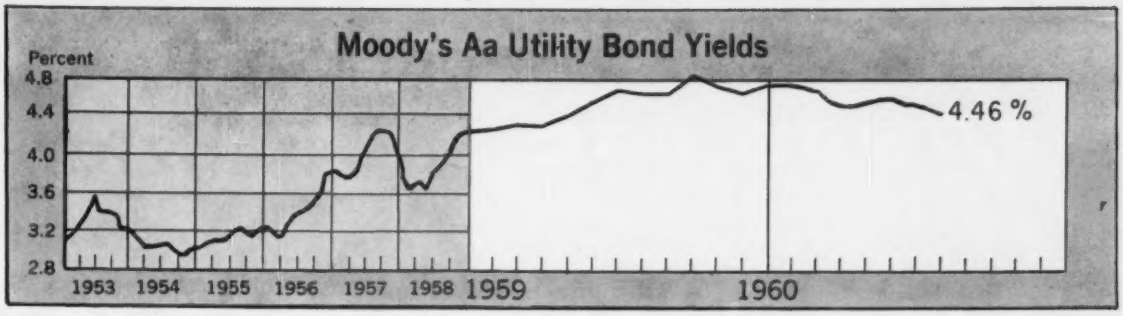
Where Interest Rates Are Headed

Declining interest rates, at last, are cause for rejoicing amongst debt conscious utilities. Moody's "Aa" bond yields had slipped to 4.46% by the week ending July 22, their low for the year, down more than 30 basis points (0.3%) from the year's highs set in January. Moody's average, of course, tells a story only for seasoned issues. New issues are generally marketed with higher yields, ranging up to one-half percentage point or more above bonds already held by investors. If it weren't for this "interest premium," the big institutional investors who buy bonds would not set aside enough reserves to buy up new offerings; they would be content to pick up seasoned issues on the market.

Rates appear to be easing all along the line. The biggest decline, however, has been in short rates. Rates for long term borrowing have moved downward only slightly. That's because there are still enough pressures at work in long money markets to support interest rates near their 1960 highs. They include high business activity and capital spending, continuing heavy demand for long term funds, the moods of the market, and that imponderable—government.

Almost every major short rate has declined in the past three months. Many have been sliding all year. Most important of these reductions was the Federal Reserve's action to cut the discount rate (the rate central banks charge member banks for borrowing) one-half percentage point, to 3½%, in early June. Thus far, however, the prime rate (the rate banks charge customers with highest credit ratings) has not followed in sympathy. The prime rate has held the 5% line since last September.

Bond Yields: Off the Plateau?



This is clear testimony that the demand for money is still high. But the discount rate is on the verge of another dip, and this time could carry the prime rate down with it. Watch 91-day Treasury bill rates. They're a key advance indicator of Federal Reserve action. The Fed seldom allows its discount rate to wander more than 1% from 91-day rates. And 91-day Treasury bills sold at 2.131% at auction last week, down from 2.409% the week before. That's the lowest 91-day rate in two years.

Not all government pressures on rates are downward, however. It is true that there is a lot of political talk about lower interest rates as a means of stimulating spending and national growth. And this ambition could go so far as to return the Federal Reserve system under the wing of the White House—a cowering position it has not had since the Fed-Treasury accord of March, 1951. At that time, the Fed was set loose to fight inflation by raising and lowering interest rates—regardless of what its actions did to the cost of government financing. A return to Administration control in order to hold interest rates artificially low would be distinctly inflationary. Which means it would be self-defeating. Inflation has been a chief cause for the sprinting interest rates of recent years.

And don't overlook the US balance of payments as an upward pressure on rates. Foreigners now hold close to $20 billion in US currency, partly to take advantage of high US interest rates. But while the Fed's discount rate was lowered to 3½% in June, Central Banks of England and Germany had hiked their discount rate to 6%. That's quite a spread, and cause for real international concern. Government steps to set much lower interest rates here, or more important, another rampaging period of inflation, could crumble international confidence in the dollar—presently the backbone of the free world's money supply.

Business activity, too, exerts upward pressure on rates. Interest rates rise with rising business; when business slacks off, rates decline. Thus, much of the bond outlook can be read from the business indicators. And business, now, is a puzzler. The economy seems to have settled into a relaxed stride that could carry it along in strong shape for some time. Surprisingly few economists are predicting recession. Many are simply bewildered. The January boom talk was based on hopes for a breathtaking rush to rebuild business inventories. There was none. Now, the economy simply refuses to be rushed—probably a healthy sign.

It can be shown that wild inventory buildups have been a major cause of each of the three post war recessions. Now, indications are that the feast-and-famine business cycles may be giving way to a new period of sustainable, but unspectacular, growth. A period marked by excess capacity, a lack of inflation, stable and high employment (and unemployment too), relatively high capital spending, increased productivity, and plenty of consumer buying power. In short—a sensible, and moderate, prosperity. In capital markets, this will mean stable—

but high—interest rates. And also a reasonably high demand for money.

High demand for funds creates high interest rates. And in 1960, demand is holding close to 1959's record levels. Net new demands for funds by corporations this year will climb $500 million to $7.1 billion, according to Bankers Trust Co's latest survey of the investment outlook. Demands by state, local, and foreign issuers will remain at 1959 levels—about $5.8 billion. But the demand for mortgage money will decline about $2.1 billion, to a $17.1 billion level (still the second highest level on record). That puts total long-term money demand at about $30 billion, only $1.6 billion below the 1959 record.

On the supply end, there'll be almost no increase from mutual savings banks, savings and loan associations, or mutual insurance companies. And there will be no significant increase in the level of personal savings. Thus, an easing of money rates will not occur to any extreme degree in 1960. Long yields now, however, are attractive to investors and are not likely to be exceeded.

Interest rates on new, high-grade utility bonds move in a range very close to the prime lending rate (now 5%). A reduction in the prime rate to 4½% is near at hand; a fact already reflected in lower yields on new bond floats. But the prime rate isn't likely to drop much lower, certainly not below 4%, unless the nation slides into deep recession. Upward pressures on rates are still high. Thus, with the prime rate as an indicator, interest rates on new utility bonds are likely to hold near the 4½% level—and higher.

On the Big Board—Time for Readjustment?

The "what next" attitude of investors typifies the puzzling movements in the stock market since January 5. That was the day the benevolent Bull market of the Fifties was sledgehammered into its long, dreary decline. Or so it seems. Since then, investors have taken to the sidelines, the bulk of trading being done on light volume. Now, it's a standoff. The level of business hasn't done the market any good. And the market, in turn, has cast gloom on business. In every instance, impressive rallies have been followed by a flurry of selling and profit taking.

Still, the utilities have done very well. Investors have not become disenchanted with the electric companies. Quite the contrary. Utility commons are the only major industry group selling at better prices than their historic January highs. Improved earnings, however, have not been fully absorbed in utility prices, the net result being a slight decline in price-earnings ratios. But very slight. A First Boston Corp tabulation of 100 electric utility stocks last month showed the industry's common issues were still posting price-earnings ratios averaging 18.7.

A lull has settled over the market; perhaps a period of "digestion." Stock prices seem to be wandering along at depressed levels, waiting for earnings to catch up. In other words, the market seems to be waiting for price-earnings ratios to float down from roof-top heights.

For the utilities, this will mean relative stability in prices, ranging to moderate declines. With growth becoming a little less enchanting to investors, a sustained climb in prices appears a vague hope. But with utility earnings showing healthy gains alongside disappointing reports from the industrials (a recent *Wall Street Journal* tabulation showed 41 of 94 corporations reporting a dip in per share earnings) the outlook for utility common prices remains bright.

With new equity issues going to market at a cost of around 6% (before expenses) on an earnings-price ratio basis, and with utility shares continuing to command premiums above book value, the outlook for attracting new equity capital remains as favorable now as it was earlier in the year.

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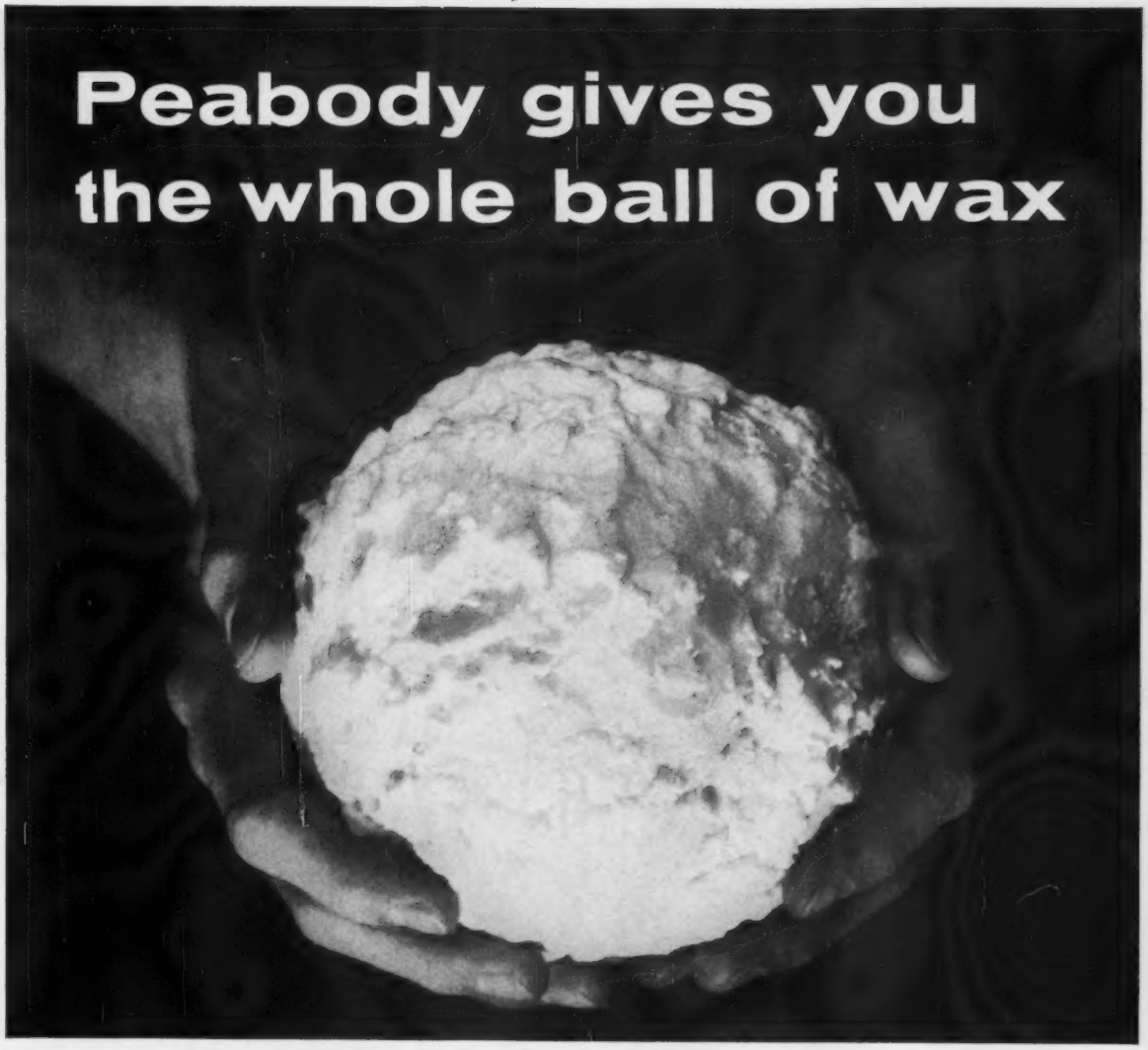

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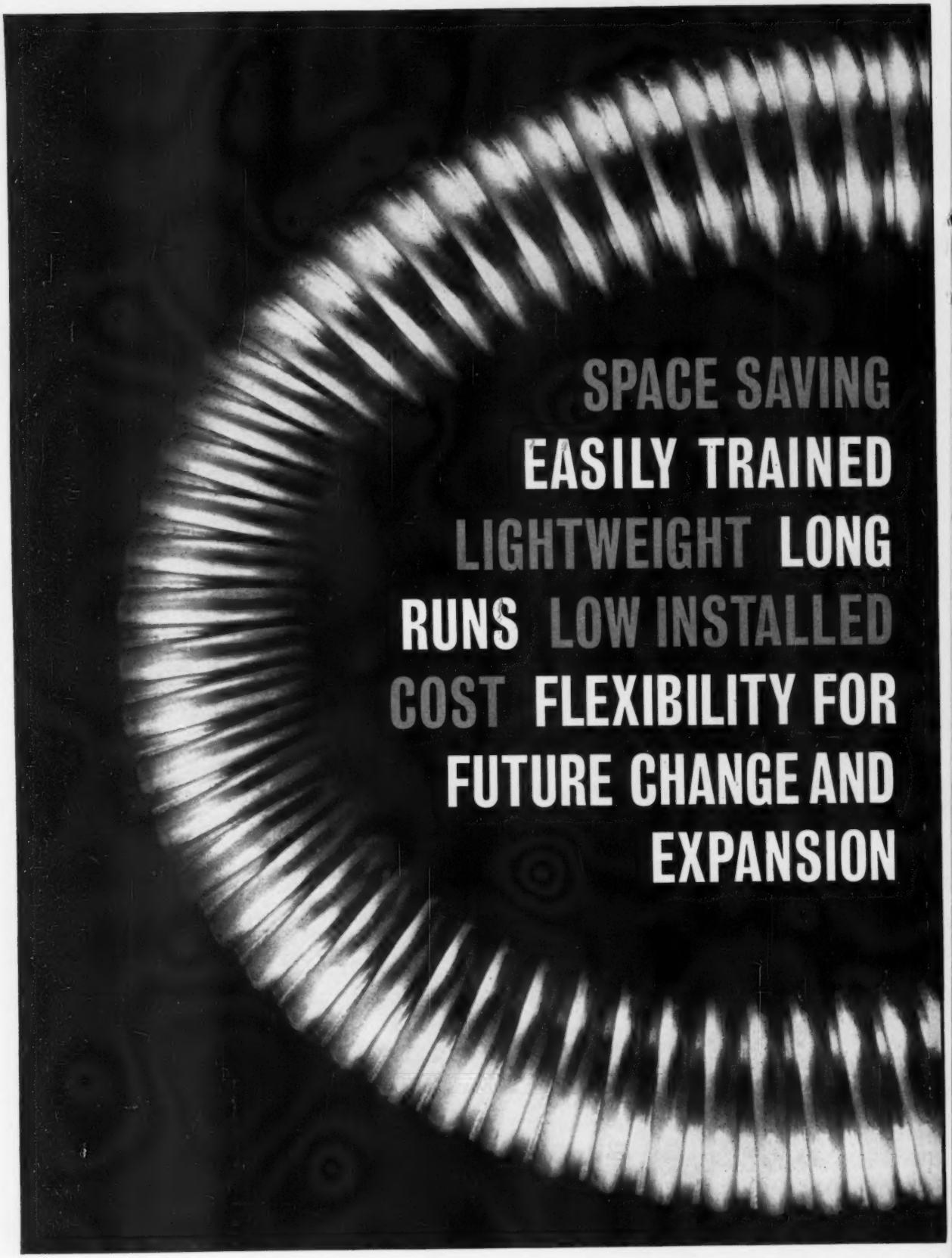
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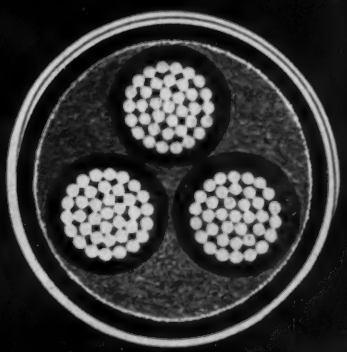

ELECTRIC BASEBOARD HEATING in this Milwaukee florist's shop has resulted in savings on the heating bill, and made the shop more comfortable for customer and clerk alike

Electric Heat Proves Best for Flowers

EARLE L. OLSON, Industrial Heating Engineer, Wisconsin Electric Power Co, Milwaukee, Wis.

Installing electric heat has solved some thorny problems for the owners of Nimmers' floral shop in Milwaukee.

When increasing business necessitated extensive remodeling, one of the objectives was to create pleasant surroundings and comfortable working conditions. The owners decided comfort conditioning would create the best atmosphere for displaying flowers and merchandise, and give even temperature control.

First step in the project was the selection of an attractive and contemporary plan for remodeling the existing building. New lighting consisting of recessed incandescents, adjustable bullet-shaped lamps and fluorescent wall panels have proved a major addition.

Next the question of a heating system was pondered. Either expanding the existing forced air heating system or installing another type of heating was considered necessary to meet the requirements of the increased space. The new building is 57 x 43 ft; the old was 20 x 30 ft.

It was found that installing electric heating equipment, plus additional insulation, would result in a saving of $600 in first costs over any other method. This coupled with an estimated operating cost of $400, which is competitive with any other heating system, made the Nimmers choose electric baseboard heating units.

Since installing electric heat the owners have found that working conditions are more comfortable, they have realized over-all savings on their heating bill—a direct result of better insulation—and customers find the shop more attractive.

Total connected load is 35 kw.

Fluorescent Tube Ballast Replacement Developed

Improved lighting efficiency and a power factor close to unit has been claimed for a French-developed lamp-reactance combination that replaces the ballast of fluorescent tubes.

With the combination, the tube is lit by the reactance and a starter. A bimetal switch then cuts the reactance out of the circuit and puts in an incandescent lamp to stabilize the current. In this way, the dead loss of power consumed by a ballast is eliminated and all current drawn is converted to light, the manufacturer claims.

In addition to stepping up lighting efficiency, the reactance-lamp combination permits smaller physical packages for fluorescent lighting fixtures, it is claimed.

Patent for the combination is held by the Centre National de la Recherche Scientifique of Paris.

Webster Named National Electrical Week Chairman

Harold A. Webster, president of the National Electrical Contractors Assn, has been elected chairman of the 1961 National Electrical Week.

Also president of T. Frederick Jackson, Inc, a Long Island New York electrical contracting firm, Webster succeeds N. J. MacDonald, president, Thomas & Betts, Inc.

Other officers for the 1961 observance are: T. O. McQuiston, vice president, Metropolitan Edison Co, vice chairman; Arthur W. Hooper, executive director, National Assn of Electrical Distributors, secretary; and L. W. O'Brien, manager, monogram and syndicated information, General Electric Co, treasurer.

NEMA Heating Symposium Papers Available

A 232-page handbook covering many facets the electrically heated home has been released by the National Electrical Manufacturers Assn. It contains transcript of 47 papers delivered at the First Na-

(*Continued on page* 82)

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To keep pace with the growing market, we are now manufacturing seamless round tapered aluminum lighting standards for street, highway and area lighting . . . . . in addition to our line of steel and aluminum octagonal shafts.

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tional Electric House Heating Exposition in Chicago in March.

The book contains information on technical, merchandising, installation and growth aspects of electric heating. Copies are $5 each and are available from National Electrical Manufacturers Assn, 155 E 44th Street, New York 17, N. Y.

RCA to Manufacture Electroluminescent Panels

Radio Corp of America will enter the relatively new field of electroluminescent lighting, manufacturing the panels for consumer, industrial and military uses.

The panels, which will come in green, blue, yellow, orange, or white, will be merchandised under the trade name, "Panelray." Available in five sizes, each will have three different ac voltages—125, 250 and 600 v.

SELLING BRIEFS

Electric heating sound slidefilms, instruction manuals and information booklets are available from General Electric Co. Materials designed for consumer groups include two 12-min sound and color slidefilms, and illustrated booklet describing electric heating systems and their advantages. Write: Electric Resistance Comfort Heating Section, GE, Appliance Park, Louisville 1, Kentucky.

"Comfortable Electric Warmth for the Entire Home," a flip chart **sales training course** on electric heating is available from Edison Electric Institute. Program comes in three forms: complete electric heating sales training and information course, $75; electric heating information portion only, $50; or combination of electric heating and appliance sales training courses, $149.50.

Street and highway lighting standard catalog has been prepared by Pfaff & Kendall. Details include luminaire specifications, arms, bases, and anchorage. Entire catalog is cross indexed. Write for ALS-5,

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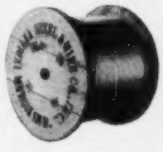

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INDIANA STEEL & WIRE COMPANY, INC.
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Pfaff & Kendall, 84 Foundry St, Newark, N.J.

A **lamp** which is smaller than a postage stamp, yet provides as much light as a 150-w bulb, has been developed by General Electric Co, in cooperation with North American Aviation. Although now destined for airplane wing tips, the bulb will someday be available for home use. Shaped like a tiny envelope bulging slightly in the middle, the bulb is ½ in. sq, and made of quartz to withstand high temperatures.

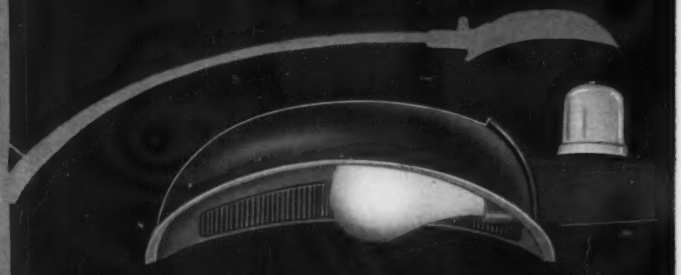
Fifteenth International Heating & Air Conditioning **Exposition** will be held at Chicago's International Amphitheatre Feb. 13 to 16, 1961. Exposition, sponsored by American Society of Heating, Refrigerating and Air Conditioning Engineers, will include an array of electric heating equipment.

Recommended **lighting practices** covering parking areas have been published by Illuminating Engineering Society. "Recommended Practice for Outdoor Parking Area Lighting" describes outdoor lighting equipment, pole spacing and mounting heights, plus minimum illumination requirements, color, economics and recommended maintenance. Publication available from IES, 1860 Broadway, New York 23, N. Y., at 50¢.

National Mineral Wool Assn is promoting **home air conditioning** in its third annual nationwide campaign. Group is sponsoring an all-air conditioning issue of Home Planning, a newspaper editorial service consisting of 12 articles and pictures explaining the advantages of whole-house air cooling and window air conditioners. Importance of proper insulation is emphasized. One free copy is available; copies in quantity, 3¢ each. Write: Sumner Rider & Associates, Inc, 355 Lexington Avenue, New York 17, N. Y.

Virginia Electric & Power Co has registered its 750,000 **electric customer.** Consumption of electricity by residential customers has nearly tripled since 1945, according to C. S. Bettts, Potomac district manager. Average annual use today is 3,934 kwhr.

WHEELER'S
new side-mounted
crescent reflector



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Dallas P&L Names Rogers VP

E. W. Rogers has been elected vice president and chief engineer of Dallas Power & Light Co.

Prior to his promotion he was chief engineer and head of the engineering department. In his new capacity he will retain charge of that department.

Rogers has been in the engineering department since 1923. He was named assistant head in 1947, and was promoted to chief engineer in 1956.

He is a past chairman of the North Texas Section, American Institute of Electrical Engineers, a licensed professional engineer in Texas, and a member of the Texas and National Societies of Professional Engineers.

Wood Made VP of General Electric

General Electric Co has named Laurence I. Wood a vice president and secretary. In addition to his new duties he will continue to serve as general counsel.

Wood became associated with the company's appliance and merchandise department in 1945. He became assistant to the general counsel in New York in 1946, and assistant general counsel for the company in 1948.

He served as counsel in the Small Appliance Division from 1953 to 1954 when he was transferred to counsel for the Apparatus Sales Division.

In 1958 he was appointed labor and government relations counsel.

A member of the bar in New York and Illinois, Wood is also a member of the council of the section of antitrust law for the American Bar Assn.

M. G. SMITH | D. N. SMITH | GRIMES | HUDSON

Electric Storage Battery Names Four Vice Presidents

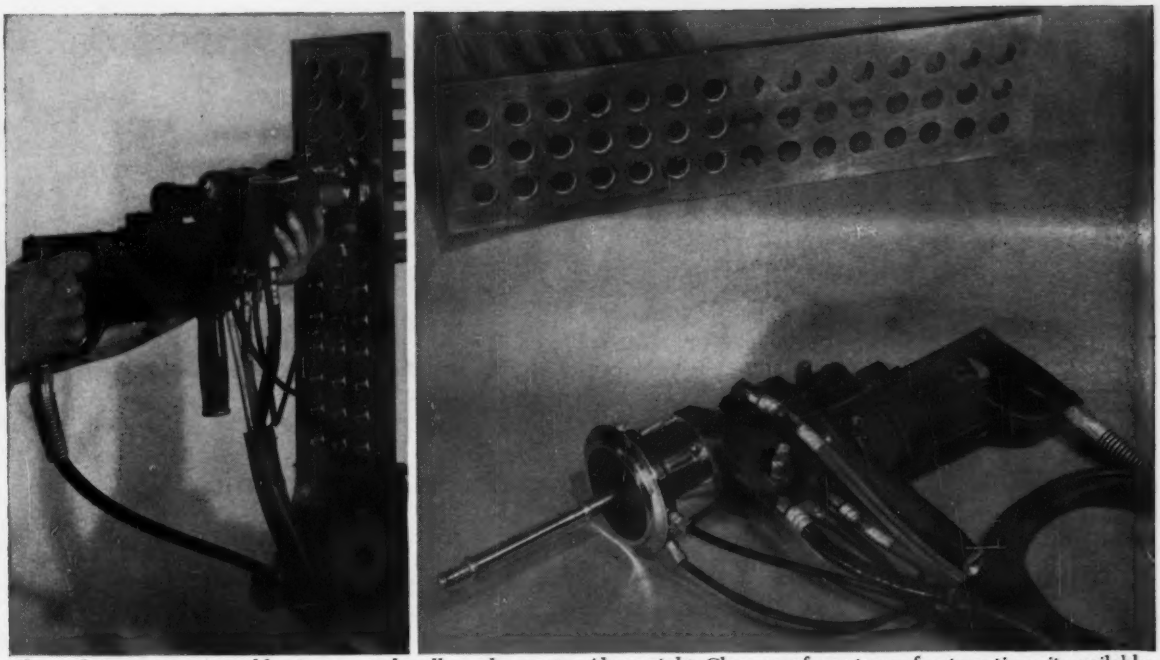
Electric Storage Battery Co has named Monroe G. Smith, vice president-Industrial Division, D. Nevin Smith, vice president-finance; Clifton G. Grimes, vice president-research; and Jay S. Hudson, vice president-employee relations.

M. G. Smith has been with the company since 1955 and has served as comptroller, general manager, Industrial Division, and vice president of Electric Storage Battery and general manager of the Industrial Division.

D. N. Smith has been comptroller, general manager of the Automotive Division, and vice president of the Division. He has been with the company since 1943.

Grimes, a retired Navy captain, was appointed director of research in 1956. Hudson was named assistant secretary in 1954, director of industrial relations, Automotive Division in 1955, and director of industrial relations for the company in 1957.

(More News About People on page 86)



Above, left: Automatic welder is easy to handle and operate. *Above right:* Close-up of one type of automatic unit available for welding tubes to tube sheets. Note uniformity of sample welds above.

Mechanized welding process makes the permanently tight heat exchanger tube joints needed in modern power plants

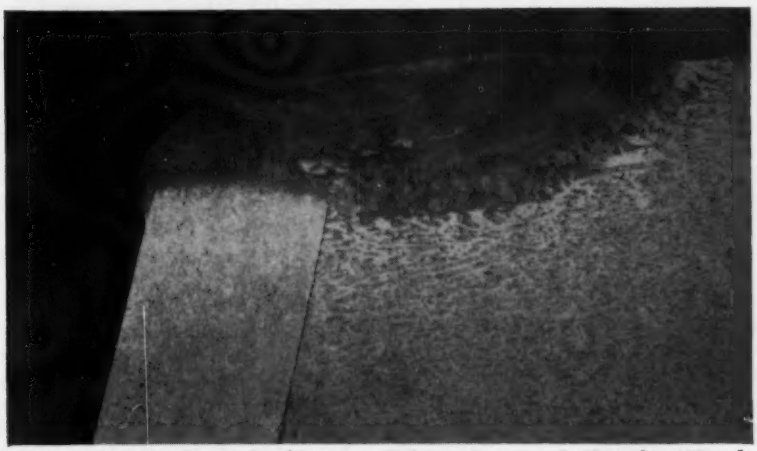
The design and operation of modern steam power plants require that tubes in condensers and feed-water heaters be installed permanently tight to prevent contamination of the boiler water.

Welding the tubes to the tube sheets will insure this. In most cases, however, welding cannot be done manually for a variety of reasons. A mechanized process must be employed to produce consistently high quality joints.

Inert-gas tungsten-arc (TIG) welding has the advantages of simplicity, good control, and protective shielding without the use of flux. Tough, dependable equipment for automatic welding with this process—such as that shown in the illustrations above—is widely available. These units make it possible to weld, without the complication of filler-metal addition, most of the tube and tube sheet combinations employed in condensers and heat exchangers.

Joints, whether a few hundred or several thousand in number, are uniform in geometry and quality. Typical are the results obtained with tubes of Arsenical Admiralty-439 on tube sheets of Naval Brass-450, as shown in the 20X micrograph reproduced at the left, below.

Technical Assistance: The Metallurgical Department of The American Brass Company will gladly help you in the selection of suitable alloys and in welding procedures and the design of joints. This service is available without obligation. See your American Brass representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.



Micrograph 20X of typical weld section. Tube is of Arsenical Admiralty-439 and tube sheet is of Naval Brass-450.

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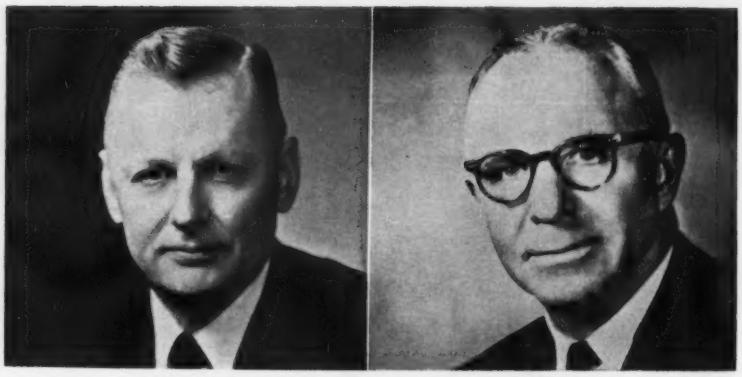

McKELVY DAVIS

McKelvy, Davis Named Senior VPs

Carl McKelvy and H. C. Davis have been elected senior vice presidents and directors of Royal McBee Corp.

McKelvy, who has been with the company since 1946, will be responsible for all production, research and development operations.

Davis has been with the firm for 30 years and will direct all marketing activities.

PERSONAL BRIEFS

Philadelphia Electric Co has named: **D. David Blaskovitz,** superintendent of the customers installation section, replacing **J. H. Schlesselman,** retired; **Blair Murphy,** assistant superintendent of the section; **William B. Morlok,** industrial sales department supervisor; and, in the residential and commercial sales department, **Daniel S. Bean,** marketing development manager; **Joseph W. Waters,** sales manager; **Thomas E. Zuber,** service manager; and **F. Hampton Morris,** assistant sales manager.

Glenn B. Harvin has been named superintendent of Carolina Power & Light Co's new relays and electronics section, a combination of the company's relay, communications, and computer groups. **R. W. Holland** will be communications supervisor in the new section.

Edward Wimberly has succeeded **John J. Snow** as chairman of the South Carolina Public Service Commission, and **Clyde F. Boland** has been named vice-chairman.

In Alaska, **Mason LaZelle** has become manager of the Matanuska Electric Assn in Palmer; **C. A. Brewer,** manager of Copper Valley Electric Assn in Glenallen; **Erling H. Orwoll,** manager of the Chugach Electric Assn in Anchorage, and **Clyde Ardin,** power engineer and advisor to the Kingdom of Laos.

Dr Otto Holden has retired as Ontario Hydro-Electric Power Commission chief engineer.

Metropolitan Edison Co has named **J. Gordon Reber** manager of its Lebanon County, Pa., district, recently designated as an operating division; **George S. Pomeroy III,** superintendent of construction and maintenance for the Central Division; and **Christian M. Daniels Jr,** Lebanon district operating superintendent.

Lord Plowden has succeeded the late **E. Ronald Crammond** as a director of the British Columbia Power Corp.

At Saskatchewan Power Corp, Regina, **Karl W. Allcock** has replaced **R. W. Jickling,** retired, as electrical distribution manager.

August Barth has been presented with a diamond-centered emblem

honoring his 50 years' service with Springfield, Ill., City Water, Light & Power Department.

William T. Nordeen has joined Washington State Public Power Supply System's Kennewick office. He will be in charge of a regional power marketing study being made in connection with the group's application to build Nez Perce dam on the Snake River.

Hoosier Engineering Co has named **O. P. Stark** president and **A. F. McCrory,** executive vice president. **Wallace O. Lee** has been named board chairman.

James H. Goss has been named president of International General Electric Co, succeeding **W. Rogers Herod** who has retired. Goss will serve until such time as a successor is appointed. **Charles D. Brown** has been appointed manager-marketing at GE's instrument department; **J. J. William Brown,** manager-direct conversion projects operation; **Harold A. Carlson,** manager-electric utility and transportation sales, gas turbine department; and **J. F. Cronin,** manager of the mining, materials handling and electrolytic processes sales unit, industrial commercial section, Apparatus Sales Division.
Other appointments at GE: **J. Richard Garvin,** manager of manufacturing, specialty motor department, succeeding **Adolph J. Rose,** retired; **Donald R. Kearns,** manager, product planning, marketing research and marketing administration, specialty transformer department; **William R. Boyd,** manager of manufacturing for the department; **Alfred J. Carletti,** manager-headquarters manufacturing, distribution assemblies department; **Thomas E. Lee,** manager—product planning, circuit protective devices department; **Frank E. Brewster,** manager of intermediates, silicone products department; and **Richard J. Thompson,** manager of polycarbonate market development, chemical materials department. New appointments in the computer department are: **Lacy W. Goostree Jr,** manager of marketing; and **George A. Hagerty,** manager, process computers.

Hermann K. Intemann has been named director of purchases of Union Carbide Corp.

New Tunable Voltmeter is also flat AC VTVM covering 1 to 600 KC

Sierra 125A
Frequency Selective Voltmeter

As a frequency selective voltmeter, Sierra 125A covers 3 to 600 KC continuously on a 40" scale. An up-converter with high IF and single conversion keeps spurious responses down 60 db. Crystal lattices provide two steep-skirted IF bandwidths — 250 cps or 2.5 KC.

As an AC VTVM, Model 125A offers response flat within ± 0.2 db, 1 KC to 600 KC, and measurement accuracy of better than ± 0.5 db. This additional mode increases the instrument's versatility and facilitates measurements on carrier systems.

Measurement range is —90 to +32 dbm in selective mode and —30 to +32 dbm in the flat mode. Signal levels are read directly on either 135 or 600 ohm lines, balanced or unbalanced. Line bridging loss is less than 0.25 db over the entire frequency range. Built-in 100 KC crystal oscillator provides accurate reference for both level and frequency calibration. Modular construction and etched epoxy glass circuit boards provide ease of access and operating dependability.

Price, $895.00 f.o.b. factory.

For complete details, see your Sierra representative or write direct.

sierra

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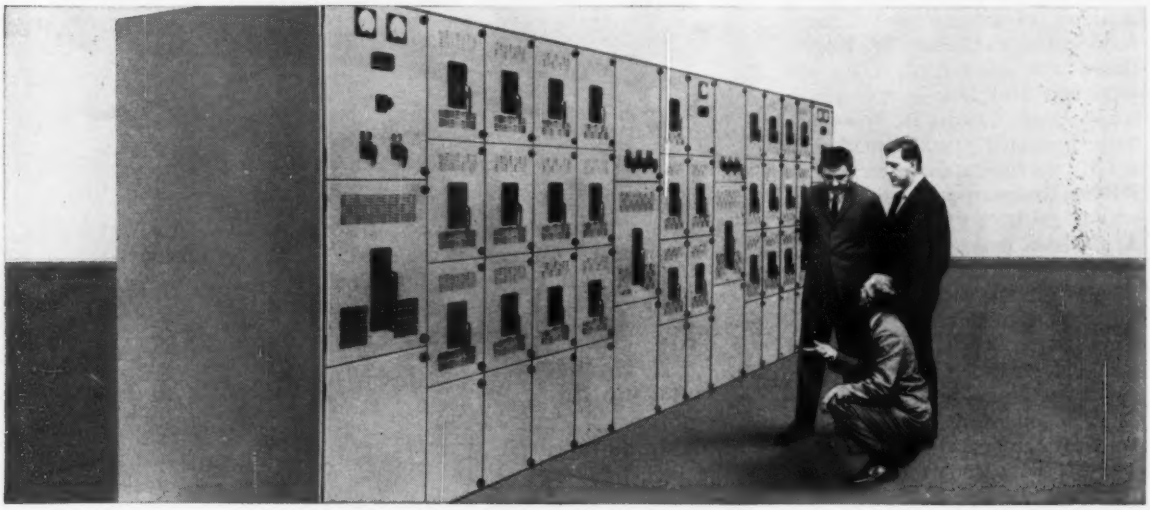
Maximum Value in Switchgear Flexibility... Safety...

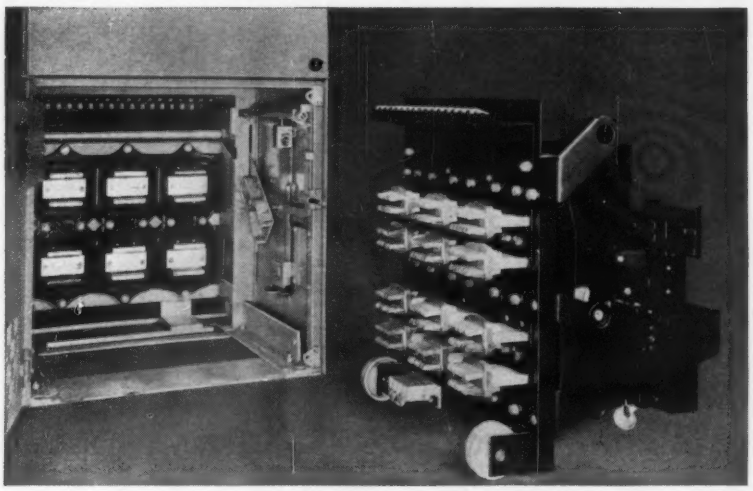
Westinghouse low-voltage, metal-enclosed switchgear is modern inside and out . . . loaded with features to assure you of a high return on your investment.

Absolute mechanical and electrical integrity is guaranteed with 100% use of Westinghouse components. Design performance is thoroughly proved in exhaustive tests at the Westinghouse High Power Laboratory.

Minimum cost is possible by specifying "Standardized" over-all design. Westinghouse "Standardized" switchgear meets all normal requirements within its rated interrupting capacity . . . eliminates additional engineering and manufacturing costs of expensive "specials."

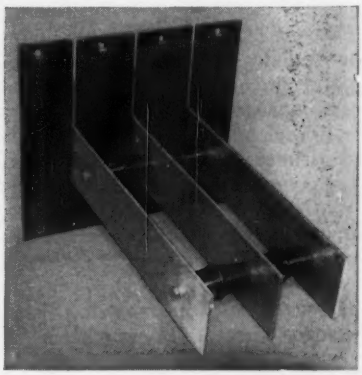
Nationwide switchgear manufacturing plants are ready to serve you . . . convenient for consultation and inspection during equipment construction. All units are thoroughly tested for conformity to NEMA standards. Where conditions permit,





Cluster-Type Disconnect Fingers permit quick inspection when breaker is withdrawn from cell. A spring-mounted floating retainer maintains full contact pressure and assures maximum current rating capacity despite minor variations in breaker alignment.

Glass Polyester Bus Supports and Short Circuit Bracing . . . provide ideal physical and electrical properties for low-voltage, metal-enclosed switchgear. The insulation is highly track resistant and flame retardant. Design of supports and bracing affords increased vertical creepage distances. Result: maximum safety with minimum maintenance.



Long-Term Operating Economy

switchgear is shipped as one completely assembled apparatus.

And, mighty important . . . *Westinghouse assumes complete, undivided responsibility for the switchgear* from planning to the satisfactory overall operation of the installed equipment. For detailed information on low-voltage, metal-enclosed switchgear, call your Westinghouse sales engineer, or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

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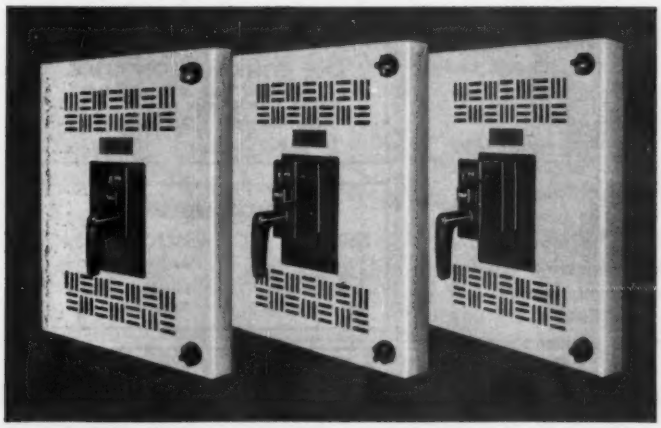
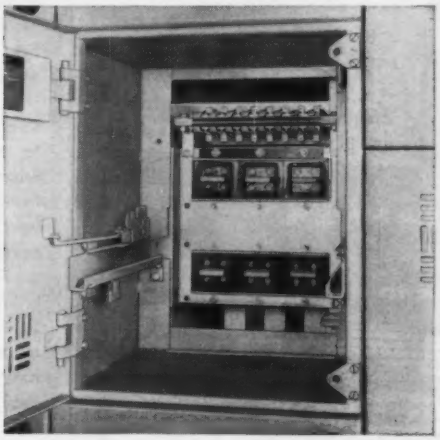
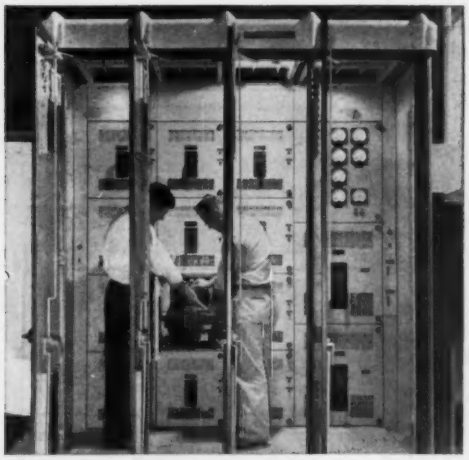
YOU CAN BE SURE...IF IT'S Westinghouse



Three-Position Drawout Design permits the De-ion® type DB breakers to be in "connected"—"test"—or "disconnected" position with the breaker door closed. The breaker can be tested in complete safety and storage space for the breaker is also provided when in fully disconnected position.

Individual Breaker Compartments include interlocks and positioning devices to assure safe removal or replacement of breakers. Dead-front design provides maximum protection and safety for operators and equipment.





"Walk-In" Aisle provides protected work space in outdoor units. Addition of this space to the weatherproof, functional design permits easy inspection and maintenance without exposure of equipment or personnel under all weather conditions.

Three Breaker Closing Mechanisms are available to match your requirements—dependent manual, independent manual, or electric—for DB-15, DB-25 and DB-50 breakers. NEMA standards specify electric mechanism for closing DB-75 and DB-100 breakers. The independent manual mechanism, shown below, assures uniform breaker operation—regardless of operator's motion—prevents delayed closing and excessive contact burning.

*Trademark

Fine Fanner Superformed Products

"Superforms* sure fill the bill for a STANDARDS ENGINEER!"

"Fanner Superformed products meet our standards all along the line . . . *technical superiority, accurate manufacture, uniform quality, dependable performance.*"

More and more Standards Engineers . . . *the men who must find BETTER ways to do things BETTER* . . . are testifying that Superforms meet the highest standards. A-1580A

FANNER
Superformed
with a
"PROTECTIVE TWIST"

ARMOR RODS . . .
Protect long-span T&D lines at supports

LINEGUARDS . . .
Protect short-span T&D lines at supports

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Repair damaged conductors

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Join two ends of conductor wire

PLASTIC PRODUCTS . . .
For conductor surface protection

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The Fanner Manufacturing Co.
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EW Needs Engineer-Editor

Ever think what it would be like to be an *Electrical World* engineering editor?

Our engineers will tell you they have a unique opportunity to see first-hand, close-up and across-the-board, a business getting more exciting by the day. Their objective status gives them access to information which few in the business can match.

Usually, an EW engineering editor covers a geographical "beat," periodically visiting utilities and electrical equipment manufacturers. He develops skill in evaluating utility and equipment design activities in terms of significance to the industry, and obtains technical articles from engineers on his beat. He works with them in editing for publication. He also originates and writes his own articles.

In this work, he travels extensively through his territory, and to many engineering conferences, maintaining contact with the best in the field. Generally, he develops a subject specialty, and is responsible for watching, analyzing and reporting trends in that subject.

We now have an opening for an engineer in our New York main office. We visualize an imaginative individual, 23 to 35, with a BS in EE or equal, and at least several years with a utility, manufacturer or consultant. He'd be conversant with a broad range of utility problems, rather than highly specialized.

As a new editor, having writing experience would be desirable, but not necessary; but he should be able to write clearly and logically, and should have prepared technical papers or reports.

The man we want should be capable of "catching fire," and of maintaining a high degree of enthusiasm.

Anyone who thinks he approximates these specs and would like a shot at the position, is urged to contact The Editor, Electrical World, 330 W. 42nd St., New York 36, N. Y.

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Minimum Requirements:

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plus at least three years experience in design of process plants and medium and low voltage distribution systems, application of switchgear, protective relays, telemetering and supervisory controls.

Age to 35 years.

Liberal salary—plus allowances, bonus and other benefits.

Qualified candidates submit details experience summary and personal data to:

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ERIE ELECTRIC CO., INC.
26 Mechanic St. Buffalo 2, N. Y.

TURBO GENERATOR UNIT

Bids will be received at the Office of the Director of Utilities until 12 noon Tuesday, September 6 on one 500 KW used turbo generator unit complete with all accessories

one 1500 KW same
one 2000 KW same
three boiler feed pumps
(two with turbine drive, one with motor drive)
two 40 HP 490 RPM 2400 volt Westinghouse motors
three 60 HP 880 RPM 2400 volt Westinghouse vertical hollow shaft motors.

Full particulars and invitations to bid may be obtained at the Office of the

Director of Public Utilities
City Hall, City of Gainesville, Florida
or call FRanklin 6-7861

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Electrical Engineer. Board layout work—power, lighting, and control systems; calculations; and occasional field contacts. Extremely wide variety of work with opportunity to enter consulting field and grow with progressive mid-western concern. P-4617, Electrical World.

Utility Engineers: E.E. and C.E. graduates with five years or more experience in utility engineering, transmission, distribution, or Substation Design, for positions in middle east. Single men or men with small families only. Prefer actual utility experience or consulting experience working with utility companies. Send complete experience and personal record to: Miner and Miner International, Inc., P. O. Box 748, Greeley, Colorado.

Generation and Transmission Cooperative in New Mexico has vacancy for graduate electrical engineer to assist with planning, installation, testing and maintenance of carrier current, supervisory control and radio communication equipment and protective relays. First class radio operators license desirable. Address experience and education record to: Plains Electric Generation and Transmission Cooperative, Inc., 2401 Aztec N.E., Albuquerque, New Mexico.

SELLING OPPORTUNITY AVAILABLE

Representative wanted for manufacturer of street lighting equipment pole line specialties. Full particulars. RW-9821, Electrical World.

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WORLD'S LARGEST INVENTORY
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Voltage Regulator G.E. "Inductrol"
110 to 240 Volts.
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Form D. Cont. Duty. 80 C Rise.
Used 1 year—Original Cost $2500.00.
Will accept reasonable offer, FOB Shipping Point.
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Poor Aladdin . . .

The best service at Aladdin's command was rubbing a lamp and WISHING for what he wanted. YOU have "Searchlight" to help you find what you want!

"CAN SEARCHLIGHT" SERVE YOU?

West Berlin Adds 350 Mw For Industrial Growth

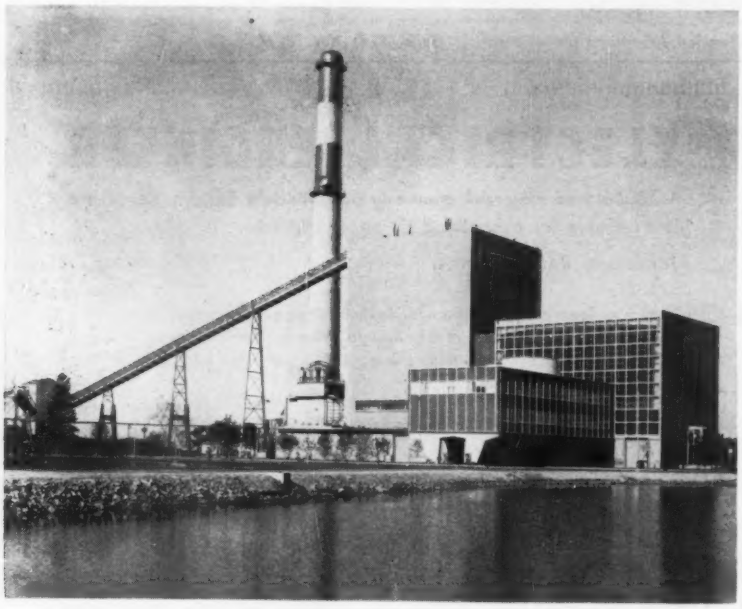
West Berlin is in the midst of a drive to become self-sufficient in power, particularly power for industrial growth.

Civil construction has been completed for the $26-million power plant "Kraftwerk Spandau I" in West Berlin's Spandau district. Heavy foundations—using 45 tons of steel and 700 tons of concrete—had to be laid for the plant's 187-ft-long 100-Mw turbine. The plant will begin operation by mid-1962.

Construction work has started on a sister plant, "Spandau II," to be equipped with two 100-Mw turbines. Also, nearby Steglitz power plant, with a 50-Mw turbine, will start operation before year's end.

All three plants are designed, constructed, and operated by Berlin's municipal power company, BEWAG.

No decision has been reached as yet about a planned nuclear power plant, a BEWAG spokesman said. A Euratom commission of experts which recently visited West Berlin advised postponement of plans until 1965.



Esthetic Design Stems Zoning Objections

Pleasing architecture and harmonizing colors at Connecticut Light & Power's new Norwalk Harbor station helped overcome objections of the local zoning board. Located on an island in the Norwalk resort area, the station uses blue aluminum siding to blend with the sky and water. An underground 115-kv cable links the station to transmission lines north of the city. Mechanical and electrical precipitators have a 99% efficiency. Meeting 26 zoning stipulations, CL&P fought a successful election to get the first 150-Mw unit in. The new unit was dedicated last month.

Urges Utility Exemption From Corporation Tax

New York security analysts will hear an Indiana Public Service Commission member recommend that utilities be exempted from the 52% corporation tax. Commissioner Robert S. Webb will appear before the New York Society of Security Analysts Aug. 17.

Webb's theory is that the public would put pressure on Congress to curtail spending if it were known how much of utility bills goes for taxes.

Replacing the income tax would be an excise tax ". . . which would clearly show the customer every month how much his service cost and how much tax he had to pay for it in addition," Webb's talks will say.

The PSC chairman believes regulatory bodies would cut rates as much as 50% if the tax were repealed.

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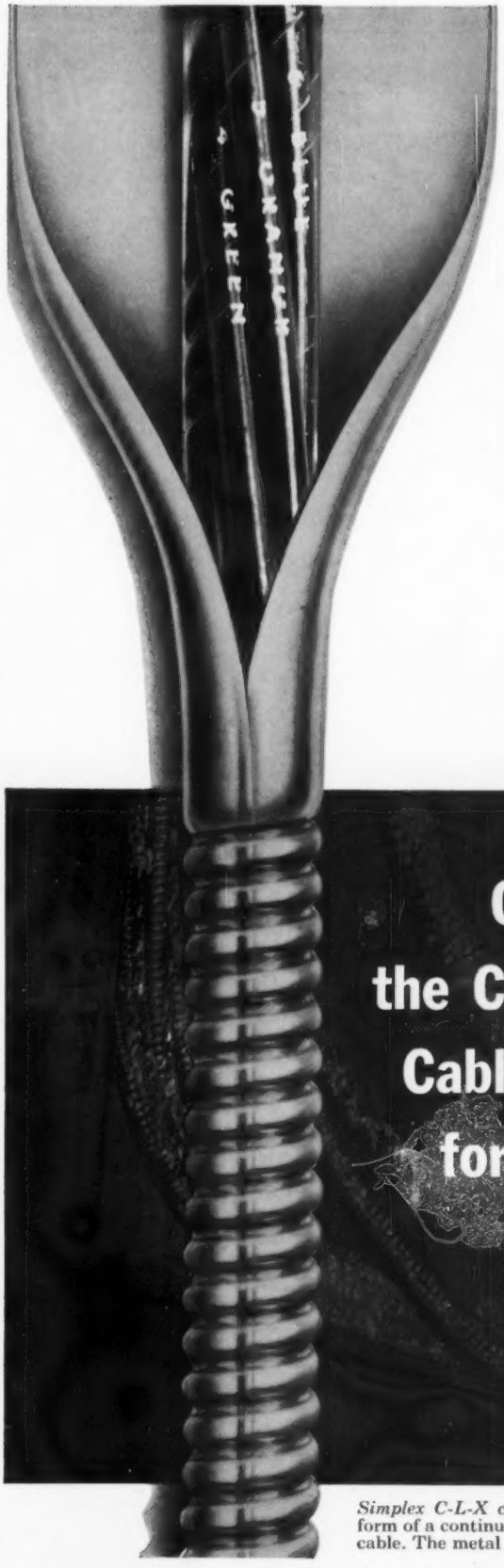

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- Completely sealed against liquids and gases.
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Available with sheaths of steel, aluminum, copper or bronze, and with or without outer plastic jacketing, Simplex C-L-X provides the ideal solution for almost any installation, particularly those in which cable life is limited by severe ambient conditions.

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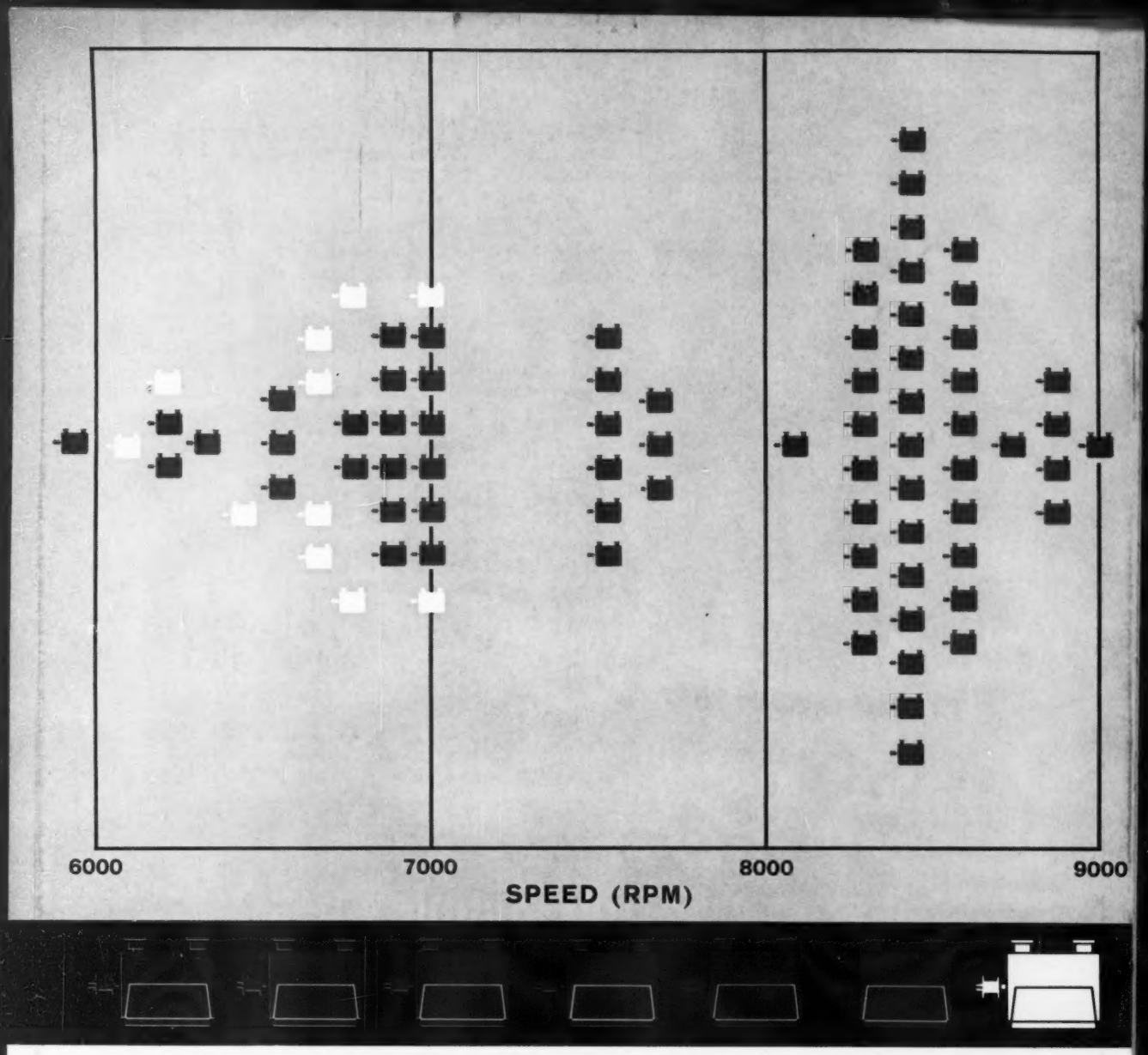
Simplex C-L-X combines cable and duct in one integrated system. Metal, in the form of a continuous flat strip, is formed into a welded tube around the insulated cable. The metal tube is then corrugated to form Simplex C-L-X.



WORTHINGTON MAKES 6 OUT OF 7 HIGH SPEED BOILER FEED PUMPS

The trend in boiler feed pumps today is to higher speeds. This provides the higher pressures needed in today's power generating equipment. An important side benefit is that it permits boiler feed pumps to be turbine driven at optimum turbine speeds. And it offers much better opportunity for standardization of equipment, including the benefit of fewer stocked parts.

In over 80 high speed boiler feed pump central station installations, above 6000 rpm, already made or on order, six out of every seven pumps are built by Worthington. And this includes two out of every three main-shaft-driven units.

Why does Worthington lead? Because of its design philosophy. It alone has taken these pumps to 9000-rpm speeds.

A Worthington design begins with minimizing shaft span, maximizing shaft diameter and keeping generous running clearances—all to reduce deflection and improve reliability. Next comes attention to critical areas: impellers are shrunk on shafts for strength and leakage prevention; metal-to-metal ring-type joints eliminate gasket failure; a balancing device compensates for axial thrust and special bearings eliminate vibration caused by oil-whip.

Other features, too, such as freedom for thermal expansion and machined twin volutes add to Worthington high-speed boiler feed pump reliability.

In a booklet just printed Worthington discusses "The ten most important features in boiler feed pumps today." From it you'll quickly understand why boiler feed pumps are now freed from the traditional 3600-rpm limitation. And you'll read basic design considerations that will help you in boiler feed pump selection. Write Worthington Corporation, Dept. 45-16, Harrison, New Jersey.

WORTHINGTON